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The Flammable Fabrics Program 1971

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U.S. Department of Commerce Report of Activities Under the Flammable Fabrics Act 1971

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** Technical note no. 749*



U.S. DEPARTMENT OF COMMERCE, Peter G. Peterson, Secretary
NATIONAL BUREAU OF STANDARDS, Lawrence M. Kushner, Acting Director,

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ABSTRACT

This Annual Report to the Congress, required by the Flammable Fabrics Act, covers calendar year 1971. Specific flammability standards outputs were standards for children's sleepwear in sizes 0 through 6X, a proposed standard for mattresses, and a finding of possible need for amendment of the children's sleepwear standard to add sampling plans for the periodic testing by manufacturers of subject garments and materials. Research included studies, in-house and under contract, on subjects such as the contribution of floor covering systems to fire spread along building corridors and the parameters related to the burning of cotton/polyester blends and of multilayer fabrics. Studies of the feasibility of reducing flammability included the effects of treatments on combustion products and the effects of heavy metal ions on flammability. Test development, in addition to that basic to the standards developments already mentioned, included work on a blanket test, an upholstered furniture test, and on a general apparel test. A series of formal training sessions was initiated to supplement the continuing informal training, presentations, etc. Extensive cooperation was carried out with HEW, the public, industry, and voluntary standards groups.

Key Words: Annual report to Congress; blankets; children's sleepwear; flammability; flammability reduction; mattresses; research; sampling plans; standards; test development; upholstered furniture.

PREFACE

The 90th Congress amended the Flammable Fabrics Act of 1953 to authorize the Secretary of Commerce to conduct research on the flammability of fabrics, on the feasibility of reducing their flammability; to develop test methods and devices; and to offer training in the use of these devices. The technical responsibility for these activities was delegated by the Secretary to the National Bureau of Standards.

The Act, as amended by PL 90-189, requires annual reports to the Congress on the above activities. The first such report covered calendar 1968-69; the second 1970; the third, contained herein, covers calendar 1971. In the latter period, a standard was published for children's sleepwear in sizes 0 through 6X, proceedings were instituted to amend the children's sleepwear standard to add sampling plans, and a proposed standard was published for mattresses. In an effort to make this information readily available to the public, the third Annual Report to the Congress is published here as a Technical Note.

SUMMARY

This report describes the work of the Flammable Fabrics Program in 1971. The program is under the Department of Commerce with the Office of Flammable Fabrics in the National Bureau of Standards acting as the Department's technical base.

Preparation of Standards

The standard for children's sleepwear was promulgated. It establishes a flammability test based on average char length and residual flame time when the fabric specimen is exposed to a small flame. This standard becomes effective July 29, 1972, although garments which do not pass the test may be manufactured for another year if they are appropriately labeled.

A mattress standard was proposed. The test requires that a mattress not ignite when cigarettes are placed on its smooth surface, in the tufted depressions, and along the taped edge.

Considerable progress was made on a test, intended for a proposed blanket standard, which determines if conditioned blanket specimens ignite when exposed to a small flame for one second.

Proceedings were instituted for a possible amendment of the Children's Sleepwear Standard to add a sampling plan which would specify pre-market testing procedures.

Research

The study of carpet hazards was expanded. Twenty experiments in a corridor study were completed using various combinations of carpet, underlayment, ceiling finish, air movement, and other floor systems. Many carpets burned the full 30 foot corridor length, and all produced excessive smoke. In order to make a practical carpet test for these hazards, developmental work was done on a procedure for scaling down from 30 foot corridors to laboratory scale.

Because more people may die from "smoke inhalation" than from burns in building fires, studies were made of the factors affecting production of toxic substances, types of smoke hazard, and measurement techniques.

Laboratory tests of burning cotton/polyester blends and multi-layer fabrics indicated that their flammability cannot be predicted from the individual properties of the single components. For instance, various cotton/polyester blends did not respond uniformly to the use of cellulosic flame retardants: the total heat output from cotton-rich blends was reduced but the heat output from polyester-rich blends was increased.

A joint fire investigation team was established at the Bureau to check fires of special significance and several fire investigators were contacted to report on the role of interior furnishings in fire growth.

Textile studies of how flames spread and the flammability effect of chemical composition were continued under the Government Industry Research Committee on Fabric Flammability.

Reduction of Flammability

Studies were conducted of the difference in combustible gases produced when certain treated and untreated textile materials were exposed to high temperatures (pyrolyses). The possible use of heavy metal ions to reduce textile flammability was investigated.

Test Development

Progress was made on tests for upholstered furniture using cigarettes, the most likely ignition source. Work was begun modifying the present apparel test method.

Training

A series of formal training sessions on flammability testing was begun to complement informal training. Additionally, drafts of test methods and standards were prepared and 12 technical papers and reports were published.

Cooperation with Public and Private Agencies

Presentations were made at legislative hearings and numerous congressional inquiries were received and answered. More than 30 presentations were made to public and industrial groups, and OFF staff participated in technical committees to exchange information. High foreign interest in the technical studies was reflected by visits to OFF from 12 foreign nations, a 7 nation ISO delegation (including the U.S.S.R.), and an international study group. Nearly one-fourth of OFF staff time was spent receiving hundreds of visitors and answering thousands of inquiries. OFF also cooperated in the preparation of 9 television presentations about flammable fabrics.

Accident Investigations

OFF cooperated with HEW in carrying out accident investigations by testing recovered items, analyzing accident reports, and reporting these results. The OFF system was fully computerized and all cases were put into the data base. The computer has been queried about possible needs for new standards and about the hazards of specific product categories. Cooperation was maintained with FTC, fire officials, NFPA, and private fire investigators in reporting fabric fires.



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1. INTRODUCTION

The Flammable Fabrics Act (15 U.S.C. 1193 as amended, Sec. 3, Public Law 90-189, 81 Stat. 568; hereinafter referred to as the Act) authorized the Secretary of Commerce to set new and amended flammability standards or other regulations, including labeling, for a fabric, related material, or product, when needed to protect the public against unreasonable risk of the occurrence of fire leading to death, personal injury, or significant property damage.

The Secretary of Commerce reserved the authorities to adopt final flammability standards, to select members of the National Advisory Committee, and to receive their comments on proposed standards. The Secretary delegated to the Assistant Secretary for Science and Technology the responsibilities for issuance of proceedings for the determination of flammability standards, and for chairing the meetings of the National Advisory Committee.

The Act authorizes appropriate activities to provide the basis for standards, and states in part:

"Sec. 14(a) The Secretary of Health, Education, and Welfare in cooperation with the Secretary of Commerce shall conduct a continuing study and investigation of the deaths, injuries, and economic losses resulting from accidental burning of products, fabrics, or related materials. The Secretary of Health, Education, and Welfare shall submit annually a report to the President and to the Congress containing the results of the study and investigation.

(b) In cooperation with appropriate public and private agencies, the Secretary of Commerce is authorized to--

(1) conduct research into the flammability of products, fabrics, and materials;

(2) conduct feasibility studies on reduction of flammability of products, fabrics, and materials;

(3) develop flammability test methods and testing devices; and

(4) offer appropriate training in the use of flammability test methods and testing devices.

The Secretary shall annually report the results of these activities to the Congress."

The Secretary delegated responsibility for activities under Section 14(a) and 14(b) to the National Bureau of Standards by revision of Department Organization Order 30-2A dated October 1, 1968. All activities under the Act, including those under Section 14, are conducted to contribute to the identification of need for standards, or to providing a sound technical basis for the development of standards and test methods. Assessment of technological practicability (including studies of the feasibility of reducing flammability), of reasonableness, and of appropriateness are parts of standards development.

This is the third report submitted by the Secretary of Commerce in response to the requirement of Sec. 14(b) quoted above, and encompasses calendar year 1971 activities. The two previous reports were submitted to the Congress and, with the permission of the appropriate Committees, were subsequently published [1, 2]¹ to make them generally available to the public.

The main body of this report discusses activities under the Act as they relate to specific standards developments. Additional sections of the report describe general activities, which underlie standards development.

At the end of calendar year 1971, the fire related activities at the National Bureau of Standards had been coordinated under a Fire Program in the Bureau's Institute for Applied Technology. Within the overall Fire Program, 31 members of the scientific and supporting staff were employed in activities directly supporting the Office of Flammable Fabrics (OFF), to provide the technical base for mandatory standards development. The Office of Fire Programs has formalized and enhanced the previously informal coordination between activities under the Flammable Fabrics Act and those under the Fire Research and Safety Act of 1968 (Public Law 90-259)[3] and the long standing building fire research program under the organic act of NBS.

In addition to Fire Program personnel, OFF funded two man-years of work in the Office of Textiles of the Department of Commerce to maintain liaison with the industries affected by the Act or by standards resulting from implementation of the Act, and to furnish economic impact studies in the areas concerned with the proposed standards. OFF also funded supporting efforts of other NBS personnel.

¹ Figures in brackets indicate the references at the end of this paper.

2. PREPARATION OF STANDARDS

2.1 Standards Established

2.1.1 DOC FF 3-71, Flammability of Children's Sleepwear

A proposed flammability standard for children's sleepwear was published under the designation DOC PFF 3-70, in the FEDERAL REGISTER on November 17, 1970 [4]. In response to requests from interested parties, the period for submission of written comments was extended from December 17, 1970 to January 29, 1971, by public notice in the FEDERAL REGISTER on December 19, 1970 [5]. Public hearings were requested. A notice of the hearings was published in the FEDERAL REGISTER on December 23, 1970, [6] and the hearings were held January 14 and 15, 1971. As a result of the hearings, comments received, and further laboratory investigations, the proposed standard was modified and the final standard published, under the designation DOC FF 3-71, in the FEDERAL REGISTER on July 29, 1971 [7].

The standard for children's sleepwear is based on a vertical test with char length of the specimens and time of burning (residual flame time) of molten drips or other fragments from the specimens on the floor of the test chamber as the acceptance criteria. The test chamber is shown in Figures 1 and 2.

The texts of the standard for the flammability of children's sleepwear and of the covering notice are given in Appendix I.

A number of issues raised in the written comments and hearings were considered prior to publication of the standard. These include:

- scope
- technological practicability
- dermatological considerations
- acceptance criterion
- test equipment
- conditioning of specimens
- ignition time
- laundering.

2.1.1.1 Scope

The proposed standard's scope included any product of children's sleepwear up through size 6X and any fabric or related material intended for use or which may reasonably be expected to be used in such children's sleepwear. This

definition in its widest interpretation could cover annual production of approximately 750 million yards of fabric, of which 15 to 30 million are used in children's sleepwear. Since the purpose of the standard is to cover only children's sleepwear, the scope was changed to reflect this limit.

2.1.1.2 Technological Practicability

The children's sleepwear market is over 90% cotton and of this 70% is knit, 20% woven. Visits to factories by Department and OFF personnel and a consultant retained by OFF indicated that it is technologically practicable to produce commercially children's sleepwear garments which meet the standard. Heavyweight (winter) wovens are commercially available. The problem with lightweight (summer) woven fabrics is a significant loss of strength caused by the flame retardant treatment. Indications are that this may be overcome by substituting a newer process for that previously tried. Alternatively, lightweight fabrics may be made from permanent flame retardant treated rayon or modacrylics. In the case of knits, chemical processes are available for flame retardant treating of these fabrics. Processing techniques must be developed and new equipment obtained. Best estimates, in July, were that knit sleepwear which would pass the test could be available in quantity within 24 months. On this basis the standard was issued to become effective in 12 months (July 29, 1972), with a proviso that garments which do not pass the test may be manufactured for a further 12 months provided they are appropriately labeled. All children's sleepwear garments manufactured after 24 months must pass the test.

2.1.1.3 Dermatological and Toxicological Considerations

One of the questions raised in the comments and at the hearing was that of possible toxicological and dermatological effects from flame retardant treated fabrics. The major suppliers of flame retardant chemicals were contacted and copies of their toxicology and dermatology studies on animals and humans obtained. These studies indicated that there was no significant problem. Consumer experience with greater than 25,000 garments in the U.S. and some four million garments in England showed only two substantiated cases of contact dermatitis. Medical consultants from government and universities indicated that they could not say absolutely that there is not a problem. Industry medical consultants were satisfied that the probability of a dermatitis problem is extremely small. Experience with various new chemicals on fibers had been that about 0.001%

of people in contact with treated fiber exhibit dermatitis. Thus, in the case of children's sleepwear some 200 children per year could be expected to show a skin effect due to the flame retardant treatment. The average medical cost of a dermatitis case is about \$100.00. This contrasts to an estimated 8-10,000 pre-school children per year burned by flammable sleepwear with an average medical cost per case of \$2,500.

2.1.1.4 Acceptance Criterion

The proposed standard specified a three-part acceptance criterion: (a) no specimen may char its full ten inch length, (b) average char length must not exceed a limit which varied with fabric weight and (c) time of burning of drips or other fragments on the test chamber floor must not exceed a limit. These basic requirements were modified in the acceptance criterion for the final standard. A review of available data indicated that an average char length limit varying with fabric weight was not necessary. The criterion was, therefore, changed to specify one 7.0 in. limit on average char length for all fabric weights. The 10 second limit on time of burning of drips or other fragments on the test cabinet floor (residual flame time) was redefined for clarification and the method of measurement changed to simplify the test procedure. The 10 in. limit was retained on maximum char length.

2.1.1.5 Test Equipment

The proposed standard specified a test chamber in which a vertical burner was moved across the floor of the cabinet. This presented problems in that residue from molten drips interfered with burner movement, and was difficult to clean from the cabinet floor. The final design, shown in Figures 1 and 2, included a burner mounted on the side of the cabinet with the burner tip at an angle of 25° from vertical to minimize the chance of drips falling into the burner. The floor of the cabinet was covered with asbestos sheets to give a uniform replaceable surface on which the burning drips fall.

It had been recommended that the sample holder and, therefore, the exposed area of the test specimen be larger than in the proposed standard. A series of laboratory trials indicated no significant advantage of larger holders and no change in the pass-fail results. The exposed area was, therefore, not changed. Outside dimensions of the holder were increased

slightly to make the holder arms more rigid. The trials also indicated that a holder consisting of two plates with locating pins, shown in Figure 3, was preferable to the hinged holder and, therefore, it was adopted. The two-plate holder is more convenient than the hinged holder for testing thick samples.

2.1.1.6 Specimen Conditioning

Another recommendation was that the test specimen be conditioned in air at 70 °F and 65% relative humidity (RH) rather than, as stipulated in the proposed standard, being oven dried for 30 minutes and cooled in a desiccator for 30 minutes before testing. Sixty-five percent RH is the standard condition used by textile laboratories and if flammability test results for samples conditioned in this way were related to the hazard, then this would have been a reasonable approach. To investigate the effect of conditioning, fabrics of four common fibers were tested after conditioning to equilibrium in air at humidities in the range 65% RH to 5% RH (latter approximates oven drying and desiccating). The char length results obtained are indicated in Figures 4 to 6. These results clearly show that some fabrics fail to meet the acceptance criterion when at equilibrium with air at relative humidities up to 50% but pass when at equilibrium with air at 65% RH. Forty percent RH is recommended as the optimum relative humidity for air in a home, and lower humidities prevail in many homes during the winter months. On this basis, testing of samples after conditioning in air at 65% RH would not always provide an indication of the potential hazard.

To further check the effect of moisture, 11 children under 5 years of age wore cotton undershirts overnight for several nights. Each following morning the undershirts were tested for moisture content. The moisture contents were found to be equivalent to equilibrium with air having relative humidities in the range 35 to 54%, averaging 49%. Hence, testing after conditioning at 65% RH also would not be indicative of the condition of garments in use.

2.1.1.7 Ignition Time

The proposed standard specified that a flame impingement time of three seconds be used; if the specimen did not ignite, then the flame was applied for a further 12 seconds. The need for the two flame application times was questioned. A careful review of available data, and

further investigations, showed that some lightweight nylon and polyester fabrics passed with three seconds flame impingement and failed with 12 seconds but, in all such cases, failure was by continued melting of the fabric rather than by burning. Moderate amounts of melting without flaming is not judged an unreasonable risk. No evidence was found that celluloseics which passed on three seconds flame application would fail on 12 seconds application. On this basis the 12 second flame application requirement was deleted.

2.1.1.8 Laundering

Under the laundering requirement, a number of questions were raised concerning disposable garments, with a useful service life of less than 50 washings, and "dry-clean only" garments. The wording of the laundering section of the standard was modified to cover these products. Also, laboratory work indicated that the flammability of a garment does not change significantly with washing, provided the garment was made from fabric that meets the standard after 50 laundering. Therefore, the requirement for dry-cleaning or laundering were dropped for garments provided they are made from fabric guaranteed to meet the standard after such dry-cleaning or laundering.

2.2 Standards Proposed

2.2.1 Mattresses

A proposed flammability standard for mattresses was published in the FEDERAL REGISTER on September 9, 1971, [8]. This proposed standard and the covering notice are given in Appendix II.

The proposed standard is based on resistance of mattresses to ignition by cigarettes. Cigarettes are placed on three different types of locations; (a) on smooth surfaces, (b) in depressions caused by quilting or tufts, and (c) along tape edges. Single cigarettes are burned at three points representative of each of these locations on the bare mattress, and with the cigarettes between two sheets on the mattress. Figures 7, 8, and 9 illustrate three of the six configurations. If any one of the cigarettes ignites the mattress, that mattress fails to meet the standard. Ignition by a given cigarette is considered not to have occurred if five minutes after the cigarette has completely burned out, char on the mattress surface extends not more

than one inch in any direction from the cigarette, and there is no evidence of continuing combustion. The latter is determined by cutting open the mattress and examining the insides.

Early in 1971, as part of development of the proposed standard, an interlaboratory trial ("round robin") of the test method was completed in conjunction with the National Association of Bedding Manufacturers and the American Society for Testing and Materials. This round robin involved nine mattress types and 17 laboratories; the test procedure required that cigarettes be burned at five points representative of each location, mentioned above. Statistical analysis of the round robin results showed the test to be reproducible, and that it is necessary to test at all three location types (smooth surface, quilted or tufted depressions, and tape edges), both on the bare mattress and between two sheets on the mattress. The results also showed that the number of cigarettes burned at each location could be lowered from five to three without loss in precision and reproducibility. This reduction was incorporated in the proposed standard.

The possible effects of service use on the flammability of mattresses were considered prior to publication of the proposed standard. Two mattress types were tested: a) flame retardant latex foam and b) polyurethane foam over cotton felt. In the latter case the minimum thickness of foam required to prevent ignition of the cotton felt was determined to be 5/16 in. and a mattress was constructed using slightly thicker foam. This mattress and the treated latex foam mattress each were flexed for 100,000 cycles according to a National Association of Bedding Manufacturers (NABM) procedure to simulate use. Ignitions were not obtained on either the flexed or unflexed areas of either mattress. These results indicated no measurable effect on flammability due to service use. A test for service use, therefore, was not included in the proposed standard.

A wetting-down procedure is included in the proposed standard to be applied in cases where resistance to ignition is achieved by the use of flame retardants in mattresses. This procedure specifies that any mattress containing flame retardant treated components be uniformly wetted with two gallons of water per foot of width and then air dried for 48 hours before testing.

A number of comments have been received concerning the proposed standard. The major issues raised were:

a) better definition of items covered (scope) under the proposed standard

b) clarification of the sampling plan proposed for mattresses

c) modification of the wetting procedure for mattresses containing treated components

d) testing of components or small-scale rather than full-scale mattresses.

These comments are under study.

2.3 Proceedings In Progress

2.3.1 Sampling Plan for Children's Sleepwear

On August 14, 1971, a Notice of Finding was published in the FEDERAL REGISTER [9], that there may be need to amend the children's sleepwear standard [7] to provide a sampling plan or plans. This finding is given in Appendix III.

The flammability test in the children's sleepwear standard is destructive, i.e. the items tested are destroyed or at least partially charred. Testing every item produced - the only way to assure 100 percent compliance - therefore, is not practical. To ensure consumer protection by an acceptably high level of compliance with the standard while maintaining a reasonable frequency of testing, it may be necessary to follow statistically based sampling plans.

Comments received pursuant to the notice were mainly of two types: (a) those which stated only that plans are needed and (b) those which stated that plans cannot be developed until the variability of the test method and of industrial processes for flame retardant treatments are known.

Work is in progress on the development of suitable plans.

2.3.2 Blankets

A flammability test method has been developed for blankets. During development of the test method, a wide range of blankets were obtained and tested using an ease-of-ignition and a burn-rate test. These two tests were carried out in an American Society for Testing and Materials (ASTM) experimental tester based on the aforementioned tests, which had been developed by OFF and described in the first Annual

Report [1]. The blanket types included 100% wool, cotton, polyester, and acrylic, as well as a range of blends including polyester, nylon, cotton, and rayon.

The methods provide for measurements of (a) ignition times, which for the blankets tested ranged from less than 0.1 second to more than 5 seconds, and (b) times to burn over 6-inch specimen lengths, which ranged from less than 3.5 seconds to greater than 50 seconds. Of these two methods, ease-of-ignition appeared better able to discriminate between more and less hazardous blankets, so it was selected for further development. In the ASTM experimental tester, six concurrently mounted specimens are tested one at a time. While convenient for determining the minimum ignition time, this arrangement means that six oven dried specimens are in room air so long that the last one or two may pick up enough moisture to effect their ignitability. Also, the six-specimen holder makes it difficult to brush up the specimens' nap uniformly. These problems may be overcome by testing single specimens for resistance to ignition from a flame applied for a given period such as one second, i.e. an ignition-non ignition test.

During the development of the test method a number of other technical issues were considered. These included:

- effect of humidity
- effect of specimen mounting angle
- effect of brushing

Blanket samples conditioned (a) for several hours in air at 65% RH, 70 °F, and (b) for 30 minutes in air at 105 °C in a forced circulation oven followed by 30 minutes in a desiccator (5% RH), were tested using one second flame impingement. For some blankets, no effect of humidity was observed; for others, all five specimens conditioned at 5% RH ignited but none of those conditioned at 65% RH ignited. Based on these results, and the fact low humidities are common in many homes during winter (see 2.1.1.6), oven drying and desiccating was selected as the method for conditioning specimens.

In the ASTM experimental tester, ignition times are determined with the sample at 60° from the horizontal. The general apparel flammability test (CS 191-53) [10] requires placement of the specimens at 45°. To check the effect of angle, blanket samples were tested at 60°, 45°, and horizontal. Although no effect was observed among the three angles for ignition or non-ignition from one-second flame impingement, there were noticeable effects on the subsequent burning of the specimens.

At least some of this appeared due to the direction of the fabric weave. Also, there may have been spurious effects due to convective heat flow from the test flame during impingement on the specimen at 45° and 60°. Therefore, it was decided to place the specimens horizontally to minimize these effects.

Blanket specimens were tested with their surfaces brushed and duplicate specimens not brushed. While this did not change the pass-fail results for the blankets tested, it was noted that less variability between specimens was observed with the brushed specimens.

The test method, as developed to the year's end, is based on the resistance of blankets to ignition by a small flame. Five 7.0 cm x 7.0 cm (2-3/4 in. x 2-3/4 in.) blanket specimens are conditioned, brushed, and mounted in holders, each of which exposes a 6.25 cm (2-1/2 in.) diameter circular area of the blanket specimen. A paper monitor similar in size to the specimen with a 5.1 cm (2 inch) diameter hole is placed over the specimen and under the top plate of the holder. A 1.6 cm (5/8 inch) flame is impinged on the center of the upper surface of the exposed specimen for one second. If ignition occurs, as evidenced by charring or burning of the paper monitor, the specimen fails. Five specimens are tested and ignition of any one results in failure of the sample.

A holder with a specimen and the paper monitor in place is shown in Figure 10 and a specimen is shown under test in Figure 11.

3. ACTIVITIES UNDER SEC. 14(b)(1): RESEARCH

Research provides a portion of the basic technical information necessary for the setting of reasonable, appropriate, and effective flammability standards. The research program has as its principal objectives:

(1) more precise and quantitative identification of the hazards associated with textile fires, as guidance to the development of more appropriate test methods; and

(2) an understanding of just how fires start and grow in textiles.

Work directed toward the attainment of both objectives was continued, both internally and through cooperative programs with other agencies.

The consolidation of the Flammability Research Unit into the Fire Program's Applied Research Section permitted further expansion and better integration of research programs. Physical scientists trained in fluid dynamics and heat transfer were added to the staff so that adequate attention could be given to the physical mechanisms important to fire development, thereby complementing the predominantly chemical orientation of past programs. More laboratory space became available and several major research instruments were acquired, including an infrared spectrophotometer, a gas chromatograph, an oxygen index tester, and improved data acquisition equipment.

The expanded staff capabilities and their improved facilities permitted an increased scope of activities, which led to increased cooperation with our agencies, both government and private, and generated important support from these sources.

3.1 In-House Research

3.1.1 Carpet Flammability Hazards

A standard more restrictive than that defined by the "Pill Test" (DOC FF 1-70) [11; text Appendix II in Ref. 2] may be desirable for floor coverings for use in special occupancies such as medical facilities, schools, and multiple occupancy buildings. In 1970, the Office of Flammable Fabrics and the Fire Research Section of the NBS Building Research Division initiated a joint program to investigate the spread of fires through building corridors, with special attention being given to the effects of carpets and other floor coverings on fire spread and hazard development. The program was to include full-scale fire experiments in a simulated room and corridor test structure and supporting investigations.

Early in 1971, the Department of Health, Education, and Welfare requested the advice of NBS in establishing flammability standards for floor coverings to be used in medical and educational facilities constructed or operated under HEW rules. Following extensive discussions, HEW and NBS agreed to support jointly an expanded program to be carried out by NBS. This program includes the following three tasks [12].

- Task 1. Evaluation of the Chamber Test (U.L. Subject 992)
- Task 2. Comparison of the Chamber Test and the Tunnel Test (ASTM E-84) applied to carpets
- Task 3. Definition of Hazards from Carpets and Interior Furnishings in Building Fires

The program is currently planned to continue through June 1973.

Work on Task 1 has been completed and a report has been issued [13]. The principal objective of the Task was the evaluation of the Underwriters' Laboratories Floor Covering Chamber Test (U.L. Subject 992) as a test method for assessing the hazard potential of floor coverings in building fires. An interlaboratory comparison was carried out using five different carpet and pad assemblies tested in the four existing chambers. It was concluded that some further development work on the test is needed before it can be relied upon to give reproducible results. The relationship of the test results to the actual contribution to hazard by the carpet in a building fire is not clearly established (the same can be said of most carpet flammability test methods).

A major activity under Task 2 will be an interlaboratory study of the Steiner Tunnel Test (ASTM E-84). Twelve laboratories are participating. The following materials will be included: red oak flooring, asbestos cement board, fiberglas insulation, hardwood plywood, sheet vinyl floor covering, and three carpets (anticipated flame spread ratings low, medium, and high). The distribution of test materials has been started; the interlaboratory study will be completed in the spring of 1972.

The carpets to be used in the interlaboratory study will include some of the ones used in the Chamber Test Study and in full-scale corridor experiments. In addition, a number of other laboratory tests are being carried out on these same carpets. Thus an extensive body of data will be gathered on the response of these carpets to a variety of laboratory tests, and on their performance in a simulated full scale fire environment in the corridor experiments. These results will help to establish the relevance of the various test methods to the measurement of hazard potential and will help to identify the construction features of the carpets which contribute to specific types of fire behavior.

Activities under Task 3 center on the full-scale corridor experiments. The objectives of this task are to characterize the environment to which carpet and other interior furnishings are exposed during a building fire and to evaluate the effects of various design and operational parameters on hazard development in a corridor fire. The corridor-room combination was chosen because corridors are common routes by which flames, smoke, or toxic gases from fire in a room spread to other spaces, as occurred in several recent multiple death fires.

The facility consists of a 30 ft. long corridor with an 8 ft. x 8 ft. room opening into it from the side near one end (Figures 12, 13, 14). Air conditioning equipment permits control of the initial air temperature and relative humidity, and of air flow into the corridor during an experiment. Smoke abatement equipment has been ordered to further increase the usefulness of the facility.

Instrumentation is provided for measurements of temperature, heat flux (radiative and convective) and air velocity at many points. Smoke density and the concentrations of carbon dioxide (CO_2), carbon monoxide (CO) and oxygen (O_2) are monitored continuously during experiments. Samples of smoke and gases are collected at intervals for laboratory study (see section 3.1.2). Still and motion pictures are taken to record the progress of the experiment.

To conduct an experiment, a fire is initiated in the side room using wood cribs to simulate the fire loading in a typical occupied room. The fire is allowed to spread down the corridor and its progress and intensity are observed by various instrumental techniques. A total of 20 experiments had been carried out by the end of the calendar 1971. Principal variables in the investigation include the intensity of the room fire (fuel loading), flame spread rating of ceiling materials, presence or absence of forced air flow down the corridor, different wood and vinyl tile floors, different carpet fiber types and constructions, and the presence or absence of a pad under the carpet. A preliminary report has been prepared [14]. The following qualitative observations have been made:

(1) Fire spread the full length of the corridor in each of several experiments in which the only combustible materials in the corridor were carpet and underpad. This was true for all four different carpets used thus far.

(2) This initial rapid flame spread involved only the pile surface of the carpet. Backing and pad did not become seriously involved until a later stage of the fire.

(3) Fire spread only half the corridor's length when the ceiling finish was gypsum wallboard (very low combustibility) and the floor covering was one particular carpet without pad; fire spread the full length with the same carpet, no pad, but a cellulose particle board ceiling finish (flammability comparable to oak flooring).

(4) Radiation, from the hot ceiling and from flames, appears to provide the necessary energy to cause the fire to propagate over the carpet surface.

(5) The principal role of a pad during the early phase of the fire is to keep heat in the carpet, thereby causing the carpet to burn more readily.

(6) A mild forced draft down the corridor (~ 100 ft/min, 1 mph) delayed ignition, presumably by increasing heat loss from the corridor, but caused very rapid flame spread once ignition occurred.

(7) All carpets tested produced copious quantities of dark smoke. Visibility in the corridor was reduced almost to zero during the period of active carpet burning.

More quantitative information is being developed from the analysis of the large volume of data collected during these experiments. A high speed data acquisition system has been added to the facility and computer programs have been developed for reduction of the data from the tape records.

To aid in the interpretation of the corridor experiment results and the results of the various laboratory flammability tests, studies of the thermophysical properties of floor and floor covering systems are being carried out. Figure 15 shows some of the results from preliminary calculations of temperature distribution through a carpet with various backing materials when subjected to a constant radiant flux on the top surface. It should be noted that up to 90 seconds (the approximate burning time of the "pill") the surface temperature is insensitive to the nature of the backing because the thermal wave has not penetrated to the back of the carpet and little heat is lost. However, after 5 or 6 minutes, a time characteristic of the chamber test or the corridor experiments, the surface temperature is much higher for a carpet with pad than for the same carpet on a masonry floor. More refined calculations will take into account the radiative properties of the carpet surface and the non-homogeneity of the carpet structure. Flame propagation over the heated carpet surface will be studied experimentally. Further development of this concept might lead to a simple test method for evaluating the flammability properties of carpets under simulated fire exposure conditions.

Because of the urgency of resolving questions relating to the suitability of the various proposed carpet flammability test

methods, the Man-Made Fiber Producers' Association has sponsored a Research Associateship at NBS for the purpose of investigating these problems. An apparatus has been constructed consisting of an 8 ft. long experimental duct of variable cross section (from 4 ft. by 4 ft. to 1 ft. by 2 ft.), a precisely controllable variable air supply, a gas ignition system, an exhaust duct, and instrumentation for recording temperature, radiation and air flow data (Figure 16 and 17). The equipment is designed to assist in scaling down from the full scale corridor experiments to laboratory scale test apparatus. Experiments have been carried out to evaluate the effects of cross section, air velocity and ignition intensity on carpet burning. Further experiments are expected to help define the parameters of a laboratory test which are necessary to provide a simulation of such real fire conditions.

3.1.2 Products of Combustion

Many of the fatalities occurring in building fires are attributed to "smoke inhalation" rather than to burns, yet the nature of the hazard from the gaseous and particulate products of combustion is not well understood. Investigations are underway with the objectives of (1) developing better methods of characterizing and quantifying the products of combustion of textile materials, (2) measuring smoke and gas development from carpets and other interior furnishings in full scale building fires, and (3) correlating the results of full scale and laboratory experiments.

The corridor experiments described in the previous section provide a convenient vehicle for large scale smoke and gas measurements. Carbon monoxide (CO) carbon dioxide (CO₂), and oxygen (O₂) concentrations are monitored continuously during the course of an experiment. "Grab samples" are taken at intervals for laboratory analysis of minor constituents by infrared spectrophotometry, gas chromatography, or mass spectrometric methods. Smoke development is monitored by measuring the decrease in light transmission at three locations along the corridor. However the smoke produced in the corridor by a carpet on the floor soon becomes so dense that accurate measurements have not been possible. Dilution techniques are being investigated to increase the range of accurate measurement. Various methods are being used for collecting samples of the particulate matter in the combustion gases. The problem is made more difficult by the high temperatures and the presence of large amounts of condensable tarry liquids in the smoke from burning textile materials. Methods are being developed for characterizing these liquid products, using a combination of chemical separation and infrared and gas chromatographic analysis.

A laboratory combustion chamber has been constructed which permits the burning of samples of textile materials under controlled conditions of ventilation, initial gas composition, and energy input. Combustion rate (weight loss), smoke density, and gas composition can be measured continuously. Conditions which give results which correlate with the full scale experiments will be sought as a step toward the development of more meaningful test methods.

3.1.3 Thermochemistry of Burning Fabrics

The heat release from fabrics burning freely in air is measured by means of an isoperibol calorimeter. This heat release is less than the standard heat of combustion since a portion of the fabric remains as a carbonaceous char and some of the gaseous products are incompletely oxidized. A combustible gas meter has been placed in the exhaust stream from the calorimeter to measure the amounts of unburned gases, so it is possible to obtain a complete heat balance on the burning of the fabric sample.

This equipment has been used for (1) evaluation of flame retardants for cellulosic fabrics, (2) study of the burning of cotton/polyester blends, and (3) study of the burning of multi-layer fabrics. Two papers describing this work were presented at the Fall National Meeting of the American Chemical Society [15, 16] and a third paper has been accepted for the Spring, 1972, meeting [17].

Studies of cotton/polyester blends indicate that the thermochemical properties of the blends can not be predicted from the properties of the pure components. The use of cellulosic flame retardants reduced the total heat output from the cotton-rich blends but increased the heat output from the polyester-rich blends (Figure 18). The results reveal that the combustion of polyester in the blend depends on the rate of combustion of the cellulosic component. Decreasing cellulosic content in the blend or increasing add-on of cellulosic flame retardant tends to reduce the combustion rate of the fabric and increase the combustion of the polyester component (Figure 19). Preliminary experiments with multi-layer fabrics indicate drastic differences in thermochemical behavior as compared to the behavior of single layers.

3.1.4 Field Studies of Fires

During 1971 a joint fire investigation team was established at NBS, combining fire investigators from the building research, fire services, and flammable fabrics projects. Under the plan, personnel from one or more of the NBS fire projects would be sent to investigate fires of special significance. In addition to collecting information on these fires for NBS, the investigators offer cooperation with local or state government investigations of the same fires. In 1971, NBS investigators were sent to investigate fires at the Lil-Haven Nursing Home in Salt Lake City, Utah, the Geiger Nursing Home in Honesdale, Pennsylvania, and a residence fire in Washington, D.C. in which five children died. In addition, NBS contracted with several fire investigators to obtain their reports on unusual aspects of various home and office furnishings fires. Among the fires they investigated were those at the Westminster Terrace Presbyterian Home for Senior Citizens in Buechel, Kentucky, the Pick-Carter Hotel in Cleveland, Ohio, a multiple residence building in Boston, Massachusetts, and 25 fires in or near Washington, D.C.

3.2 Contract Research

External contracts with academic and commercial organizations provide a means of supplementing the OFF research by making available technical experts and special facilities for application to specific problems, as well as stimulating interest in textile flammability research in the scientific community. This program will be continued as suitable opportunities arise. Contracts which were active during 1971 are described below.

3.2.1 Dynamics of Textile Fires

In April 1971 a request for proposals for a study of "Dynamics of Textile Fires" was issued [18]. Eighteen proposals were received in response to the solicitation. Following a competitive evaluation, a one year contract was awarded to the Factory Mutual Research Corporation [19].

The objective of the program is to apply recent progress in understanding the mechanism of flame propagation over the surface of liquids and solids to the more difficult problem of flame propagation over the surface of textile materials. The program is described in the following summary of the work statement:

(1) The contractor will develop a physical and mathematical model of the spread of flame over the surface of textile materials. The model should describe flame propagation; transient phenomena associated with and leading to ignition will not be considered in the present program.

(2) The initial model is expected to describe an idealized system, e.g., a plane fabric surface burning in an upward direction at an angle of 45° in air. The model should be extended, where possible, to include the effects of such parameters as orientation in the gravitational field, forced convection, atmospheric compositions, temperature, pressure, and composition and structure of the textile material.

(3) The contractor may perform simple combustion experiments in his own laboratory to provide an insight into the mechanics of flame spread and to check predictions based on the model. The Government will provide standard test fabrics for this purpose.

Work on both the theoretical and experimental phases of work is under way and a first quarterly report has been issued [20].

3.2.2 Flammability and Combustion Behavior of Textiles

The Office of Flammable Fabrics has joined in supporting a multi-sponsor program being carried out at the Textile Research Institute [21]. The general objectives of the program are:

(1) To establish the effects of chemical composition and gross physical structure of textiles on their inherent flammability behavior.

(2) To identify the controlling mechanisms of the combustion processes which occur during the flaming of textile substrates.

Specifically, a portion of the program effort will be directed toward characterizing the burning properties of the GIRCFF Fabrics (Sec. 3.3) using the TRI Flammability Analyzer. This apparatus gives precise measurements of fabric flame propagation rates. The results should be useful in the numerous research programs which utilize these fabrics.

3.3 Government-Industry Research Committee on Fabric Flammability

As reported last year, the Government-Industry Research Committee on Fabric Flammability was organized for the purpose of sponsoring research aimed at developing factual information on hazards associated with apparel fabric fires. The research program is supported with funds provided by the American Textile Manufacturers Institute, the National Cotton Council, and the Man-Made Fibers Producers Association, each of which contributed \$25,000, and by the National Science Foundation, which contributed \$92,900. The Office of Flammable Fabrics of the National Bureau of Standards provides scientific and technical guidance.

In November 1970, the Committee selected four leading industry and university facilities to receive funding for research under this cooperative program. These projects include:

- . A Factory Mutual Research Corporation (Norwood, Mass.) study of pre-ignition heat transfer through a fabric-skin system subjected to a heat source;
- . A Georgia Institute of Technology investigation of hazards from burning apparel and the relation of hazards to test methods;
- . A Gillette Research Institute (Rockville, Md.) inquiry into the probability of ignition and the effect of garment construction and multiple-fabric layers, using full-size mannikins in the experiments;
- . A Massachusetts Institute of Technology series of experiments on measurement of burn-injury potential of fabrics.

Preliminary reports indicate that significant contributions are being made to the understanding of the basic phenomena involved in fabric fires, and the relationship between the properties of fabric products and the hazards they represent.

4. ACTIVITIES UNDER SEC. 14(b)(2): REDUCTION OF FLAMMABILITY

4.1 Pyrolysis of Textile Materials

The burning of textile materials involves an initial pyrolysis to produce gaseous fuels which mix with air to support a gas phase flame. Many flame retardants take effect through a modification of the pyrolysis reaction to reduce the supply of gaseous fuel to the flame zone. A high rate pyrolysis apparatus, which gives a direct measure of the amount of combustible gas evolved during the rapid pyrolysis of organic fuels, was used to study a number of polymer-retardant systems [22].

The pyrolytic behavior of a series of metal oxycelluloses, supplied by the NBS Paper Evaluation Section, was examined for evidence of flame retardant action. The decomposition kinetics showed little overall differences among samples with the metal ions located in three different positions in the organic structure of the materials. Both increases and decreases in thermal stability were observed among the various samples, as characterized by the oxygen index method. The changes in flammability were in disagreement with the common generalization that retardancy accompanies a lowering of the decomposition temperature.

A cooperative study was carried out with Stevens Institute of Technology. The decomposition kinetics of a number of polymers were determined in the pyrolysis apparatus by OFF. The results were in good agreement with those derived from controlled surface combustion experiments at Stevens. In cooperation with Clemson University, retardant treated nylon samples were studied and evidence was found to indicate the retardant acted by a vapor phase inhibition mechanism.

Pyrolyses of a number of carpet fibers were carried out to support the studies of carpet flammability. An acrylic fiber was found to undergo a distinct two stage pyrolysis which appears to correlate with the observed behavior of the carpet in various flammability tests. A further study of this effect is planned.

4.2 Effects of Heavy Metals

Scattered references in the literature suggest that small concentrations of heavy metals may show pronounced flame retardant effects in a variety of fuels. For example, the chrome dyeing of wool confers a considerable degree of

fire resistance on the product. A program has been started to study the prevalence and mechanisms of such effects and to determine whether or not retardant processes based on heavy metals may be practical.

Ethylene-acrylic acid copolymers are being converted to their metal salts by an ion exchange technique in the Polymer Chemistry Section. The products are evaluated by pyrolyses, oxygen index, and combustion methods for evidence of retardant action. Of particular interest is a nickel-containing copolymer which shows a significant increase in oxygen index, indicative of flame retardancy, while the corresponding cobalt derivative shows no effect.

A series of cotton fabrics containing metaloxy-anion derivatives were prepared by Clemson University under a contract. Some of these also show significant retardant activity. These leads will be explored further during the coming year.

In another approach to the study of inhibition reactions, a mass spectrometric system for atmospheric-pressure sampling of flames has been placed in operation by the Inorganic Chemistry Section. Used in conjunction with a quadrupole mass spectrometer, this equipment allows direct analysis of flames and gaseous pyrolysis products, including unstable intermediates. This system has been applied to a study of the antimony-halogen flame retardance synergism [23]. Applications to other retardant systems are planned.

4.3 Textile Finishing Laboratory

Plans for establishing a finishing laboratory in OFF are being implemented. The laboratory will perform three major functions. First, it will help OFF in insuring that, as required by the Flammable Fabrics Act, proposed standards are technologically practicable. It will permit OFF to acquire first hand experience with processes and finishes which impart flame retardance to fabric products. A flame-retardant process or finish which works in a laboratory is not necessarily suitable for large scale commercial production. Still, there is an urgent need for the Office to become less dependent on the technical literature or industrial contacts for information about the state of the art. The second major function of the finishing laboratory will be to assist in test development by producing fabrics over a wide range of flammability characteristics. These fabrics will then be used to

determine the ability of proposed test methods to discriminate among fabric specimens. The third programmatic thrust planned for the finishing laboratory is to assist in research on the reduction of flammability of fabric products. Work in this area will be performed in conjunction with other research efforts, and will permit studies which utilize a diversity of materials with predetermined characteristics.

A contract for the design of a finishing laboratory capable of providing the services described above has been let to the Gillette Company Research Institute. Appropriate equipment has been identified with the assistance of the contractor, procurement has been started, space has been allocated, and the laboratory should go into operation in calendar 1972.

The Gillette Research Institute provided professional services to supplement the capabilities of OFF, during 1971, by furnishing flame retardant treated fabrics as required by the OFF research program (Sections 3.1.3 and 4.1). The variety of experimental materials and treatment levels required could not be obtained from commercial sources.

5. ACTIVITIES UNDER SEC. 14(b)(3): TEST DEVELOPMENT

Several tasks of test development were carried out in connection with the development of the standards already discussed; additional work is described in two areas not yet in the formal stages of standards development.

5.1 Upholstery Systems

Studies have been started on the ignition and flammability characteristics of upholstered furniture. A cigarette ignition test similar to that used in the proposed mattress standard appears a promising approach. Fourteen representative upholstery fabrics were obtained in the weight range 6 to 17 oz/yd.² Simulated constructions of fabric over cotton felt and fabric over urethane foam-cotton felt combinations were prepared and tested. Burning the cigarettes on simulated construction samples placed horizontally as shown in Figure 20 did not result in ignition with either the cotton or urethane-cotton combination. In these cases the fabric appeared heavy enough to prevent ignition of the filling.

Some ignitions were obtained when cigarettes were burned, as shown in Figure 21, on samples having both horizontal and vertical elements, to simulate chair arms. Only the two vinyl fabrics prevented ignition with the fabric-cotton felt combinations. When the fabric-foam-cotton felt combinations were tested, ignitions were obtained with four of the fabrics. Close examination of some of the samples where ignition occurred indicated that the way they ignited was different than with mattresses. With mattresses the heat from the cigarettes penetrates the mattress and ignites the filling beneath the ticking. With the simulated upholstered furniture samples ignition of the surface fabric appears to occur with subsequent ignition of the filling.

5.2 General Apparel

The Office of Flammable Fabrics participated in a round-robin to evaluate the ASTM experimental flammability tester mentioned in Section 2.3.2. This tester is a combination of two units, an ease-of-ignition tester and a burn-rate tester. These two units, developed by OFF, were described in the first annual report [1]. Ten commonly available apparel fabrics were tested by 16 participating laboratories. The results of this round-robin are being analyzed statistically by NBS.

Although the development of the two test methods mentioned in the preceding paragraph was prompted by recognition of technical inadequacies in the present wearing apparel standard [10], the possibility of improving the basic method has also been pursued. Ways have been developed to overcome several of the recognized inadequacies and, at the end of the year, a draft of an improved version of the original method was in the early stages of review and evaluation. It is based on the original test apparatus, thereby drawing upon basic familiarity, but incorporates substantive modifications believed to be significant improvements. If the evaluation is sufficiently affirmative, consideration will be given to promulgation of the method as a proposed general wearing apparel standard, to replace CS 191-53 and CS 192-53.

6. ACTIVITIES UNDER SEC. 14(b)(4): TRAINING

The training activities authorized by the Flammable Fabrics Act were expanded during 1971 as the staff of the Office of Flammable Fabrics was enlarged. Although the nature of

the training needed did not require formal classwork until year's end, technical information was conveyed to interested individuals and groups in the several ways discussed below. One formal workshop was held on the children's sleepwear standard, the first of a planned series.

6.1 Research Associate Programs

The Research Associate Program provides a mechanism for joint support by NBS and industry of research of mutual interest. It provides excellent training opportunities for the individual Research Associates and, through them, the sponsoring industry groups.

The National Cotton Council Research Associate Program was continued for another year to complete the studies on heat release from burning fabrics, including those containing fire retardants.

The Research Associate Program of the Underwriters' Laboratories was extended, at least until the end of June, 1972. The results obtained in the full-scale evaluation of fire spread in corridors are shedding new light on the interactions of wall, ceiling, and flooring systems in a fire environment.

The Man-Made Fiber Producers Association initiated a Research Associate Program in mid 1971 to study the parameters in the Underwriters' Laboratories' Chamber Test for carpets and to model other fire exposures of carpets. A chamber was constructed with variable dimensions and interior environment for this study. Additional details have been given in Section 3.1.1.

The Office of Flammable Fabrics established a cooperative program with the National Association of Bedding Manufacturers (NABM), under which a consultant has been employed by NABM to work closely with the OFF staff to develop mattress constructions that will comply with the proposed flammability standard for mattresses (DOC PFF 4-71) [8]. Because this is largely a non-resident program, it has not been designated officially as a Research Associate Program.

6.2 Publications

Although the primary outputs of the flammable fabrics program are flammability standards, other outputs were

several reports and formal articles published this year, several of which have been mentioned and referenced earlier in this Report. The reports are identified in full as References: 2, 13, 14, 15, 16, 22, 23, 25, 26, 27, 28, and 29.

6.3 Workshop and Educational Films

A workshop was held at the National Bureau of Standards in December to train personnel of government and private laboratories in the use of the apparatus in the Children's Sleepwear Standard. The Standard was reviewed, the procedures demonstrated, and questions were answered. Thirteen individual trainees also had the opportunity to work with the test apparatus. This workshop was the prototype for a series to be continued in 1972.

Films have been prepared illustrating the flammability test methods for children's sleepwear and mattresses. These are available, on loan, to all interested parties.

7. ACTIVITIES UNDER SEC. 14(b): COOPERATION WITH PUBLIC AND PRIVATE AGENCIES

Appreciable cooperation was received in the formulation and funding of research activities, and this has been described in detail under Section 3. Also, equally significant cooperation has been received in test development, particularly with regard to participation in inter-laboratory evaluation of test methods. This too has been described in detail, under Sections 2. and 5. In addition, the Department and OFF had cooperation from and liaison with many groups, including government agencies (Federal, State, and local), voluntary standards organizations, the public, industry, the news media, and others.

7.1 Congressional Hearings and Briefings

Congressional interest in flammable fabrics issues intensified as product safety legislation was introduced and as actions by the Department extended into new product areas. Communications with individual members of the Congress and appearances before appropriate committees and subcommittees increased over 1970.

7.1.1 Hearings Statements

Testimony was prepared and presented to the following Congressional Committees and Subcommittees:

1. Subcommittee on Commerce and Finance of the House Committee on Interstate and Foreign Commerce, supporting H.R. 5066, a bill to reauthorize appropriations for the Flammable Fabrics Act.

2. Subcommittee on State, Justice, Commerce, the Judiciary and Certain Related Independent Agencies of the House Committee on Appropriations, in favor of a supplemental appropriation for funds to provide a fire test facility at NBS Gaithersburg for full-scale corridor and room fire studies.

3. Subcommittee on Commerce and Finance of the House Committee on Interstate and Foreign Commerce, supporting H.R. 5698, a bill to amend the Flammable Fabrics Act to provide for premarket testing and suitable penalties for violations of the Act and to reauthorize appropriations.

4. Subcommittee on State, Justice, Commerce, the Judiciary and Certain Related Independent Agencies of the House and Senate Committees on Appropriations, regarding the regular appropriation for the Flammable Fabrics Program.

5. Consumer Subcommittee of the Senate Committee on Commerce, regarding several consumer product safety bills. A demonstration on the flammability of children's sleepwear was made for this subcommittee.

6. Subcommittee on Science, Research and Development of the House Committee on Science and Astronautics, during oversight hearings on NBS.

7. Senate Committee on Aging, hearings on Flammable Fabrics and the Elderly American.

8. Subcommittee on State, Justice, Commerce, the Judiciary, and Certain Related Independent Agencies of the Senate and House Committees on Appropriations, requesting appropriations for the new fire facility at NBS Gaithersburg.

7.1.2 Congressional Inquiries

As the Carpet and Rug Standard (DOC FF 1-70) [11] went into effect in April, the Children's Sleepwear Standard (DOC FF

3-71) [7] was published in July, and a proposed standard for mattresses (DOC PFF 4-71) [8] was published in September, many members of Congress began receiving increasing numbers of inquiries on these subjects from their constituents. These members of the Congress and their staffs consulted with members of the Department on the details of these standards areas, as well as the flammable fabrics program in general. It became apparent that consumer and producer interests have been intensified.

7.2 Liaison With Voluntary Standards Groups

The Department of Commerce and the national voluntary standards organizations continued to draw mutual benefits from liaison. Participation in the technical committees concerned with materials or products subject to the Flammable Fabrics Act provides a forum for technical discussions of particular test procedures, related factors, and, most importantly, the relationship between a test and the real-life hazard. The Office of Flammable Fabrics and various committees have jointly participated in interlaboratory evaluations of test methods, as discussed under Section 2 of this report. Staff of the Office hold membership and participate actively in committees of the American National Standards Institute, American Society for Testing and Materials, American Association of Textile Chemists and Colorists, and National Fire Protection Association.

As the data from accident case reports were analyzed, it became clear that nearly half of all garment fires were started by matches, cigarette lighters, and cooking stoves. Although the Flammable Fabrics Act does not authorize the setting of mandatory standards for such items, obviously the designs of stoves and matches are part of the overall flammable fabrics problem. Therefore, discussions were held between OFF and representatives of the Association of Home Appliance Manufacturers, the Gas Appliance Manufacturers Association, the American National Standards Institute, and others regarding the initiation of development of standards for the cooking surfaces of stoves, within the voluntary standards effort. The aim of the voluntary standards would be to lessen the hazard of accidental ignition of clothing. Similarly, efforts are under way, but at a more preliminary stage, with regard to matches and lighters. Negotiations have been started for a contract study to make recommendations for design improvements in these products, which recommendations could be the basis for voluntary standards.

7.3 Other Liaison With Federal, State, and Local Government, the Public, and Industry

OFF has had numerous contacts with State and local officials who seek to draw upon the broad expertise in flammability that has been developed in OFF. Responses to many of these requests can be provided from existing technical information. However, occasionally the basic problems require more active participation in continuing discussions. OFF has entered into such continuing discussions with the California State Fire Marshal and the Disposables Association regarding proposed California regulations on the flammability of disposable items for use in hospitals.

Communication with interested government, consumer, and industrial groups was maintained through briefings, formal presentations, and discussion groups. These interchanges supplemented the formal comment procedures followed under the Flammable Fabrics Act and were extremely useful in explaining the provisions and consequences of new test procedures and standards, in setting priorities, and in planning research and other activities.

7.3.1 Representatives of Government and Government Agencies

- 1) Senator Howard H. Baker, Jr., of Tennessee
- 2) Staff of the Senate Committee on Commerce
- 3) Commissioner Charles Edwards of the Food and Drug Administration
- 4) Staff of the Federal Trade Commission
- 5) Driver and Passenger Protection Division, Department of Transportation
- 6) Staff of the Department of Health, Education and Welfare
- 7) National Commission for Fire Prevention and Control
- 8) National Academy of Sciences Ad Hoc Panel on Fire Programs at NBS.
- 9) British and West German government representatives accompanied by personnel from the State Department and British Embassy
- 10) National Science Foundation

7.3.2 Non-Government Organizations

- 1) American Association of Textile Chemists and Colorists and its Committee on Flammability and Fire Research
- 2) Texas Home Economics Association
- 3) Textile and Apparel Flammability Advisory Committee
- 4) Textile Research Institute

- 5) National Association of Bedding Manufacturers
- 6) American Society for Testing and Materials Committee D-13 on Textiles and Committee E-5 on Fire Tests
- 7) National Fire Protection Association Committee on Fire Tests
- 8) American National Standards Institute
- 9) Delaware Valley Consumers Council
- 10) Western States Section of Combustion Institute
- 11) Information Council on Fabric Flammability and its Committees
- 12) American Apparel Manufacturers Association
- 13) American Association of Textile Technologists
- 14) Society of Plastics Engineers
- 15) Plastics Institute of America
- 16) Texas Education Agency (In-Service Training Meeting)
- 17) Short Course on "Textiles and the Consumer", North Dakota State University
- 18) Flammability Seminar - University of California at Berkeley
- 19) Flammability Conference, Polymer Conference Series, University of Utah
- 20) Gordon Research Conference
- 21) "Textiles in the Marketplace" seminar at Framingham State College
- 22) Associated General Merchandising Chains
- 23) Latex Foam and Sponge Rubber Carpet Flammability Technical Committee of the Rubber Manufacturers Association
- 24) American Chemical Society
- 25) Carpet and Rug Institute
- 26) Plastics and Paper Conference, Technical Association of Paper and Pulp Industry
- 27) Association of Mutual Insurance Engineers
- 28) Disposables Association
- 29) Textile Information Users Council
- 30) California Fire Chiefs Association
- 31) National Cotton Batting Institute
- 32) Man-Made Fibers Producers Association
- 33) North Carolina State University short-course
- 34) Clemson University seminar

7.4 International Contacts

The standards for the flammability of fabrics, related materials, and products developed by the Department of Commerce affect import and export items, and many foreign governments are looking to the United States for leadership in the development of appropriate standards. Therefore, there is a continuing strong interest in the program, from representatives of foreign governments and foreign industry.

The Office of Flammable Fabrics received individual visitors from Australia, Canada, India, Japan, Malaysia, New Zealand, South Africa, Sweden, Switzerland, United Kingdom, Viet Nam, and West Germany. OFF staff visited Canada, Switzerland, the United Kingdom, and West Germany. In addition, OFF was visited by 21 delegates to the meeting of ISO Committee TC 92 on Fire Tests, from Australia, Belgium, Denmark, West Germany, Netherlands, United Kingdom, and the Union of Soviet Socialist Republics; and by participants in the International Fire Protection Engineering Institute, held at the University of Maryland, from Australia, Belgium, Canada, Denmark, Finland, France, Netherlands, Norway, Sweden, Switzerland, United Kingdom, United States, and West Germany.

7.5 Television and News Services

Flammable fabrics was discussed in a number of television programs during the year. Among those in which the staff actively participated or which they helped prepare were:

(1) CBS TV spent three days at the National Bureau of Standards and on another day interviewed Secretary Maurice H. Stans and Secretary of HEW Elliot Richardson for a segment of their "60 Minutes" program. The material had not been used by the year's end.

(2) Station KXJB, CBS-TV Fargo, North Dakota, general discussion, audience questions.

(3) NBC-TV News, filmed tests of carpets in relation to a hotel fire in Cleveland, Ohio.

(4) NBC (WRC) TV News, material related to children's sleepwear standard.

(5) CBS (WTOP) TV News.

(6) ABC (WMAL) TV News.

(7) "Caution" (Consumer program series, WTOP-TV, Washington, D.C.), panel discussion on "Flammable Fabrics" involved members of the National Advisory Committee for the Flammable Fabrics Act, and visuals provided by OFF staff.

(8) WMAL "AM Washington".

(9) Westinghouse Broadcasting Company, "Firetrap".

7.6 General Liaison

In addition to the liaison already described, the Department and the Office of Flammable Fabrics have responded to numerous telephone inquiries, and have handled voluminous correspondence related to implementation of the Flammable Fabrics Act. It is estimated that the Office of Flammable Fabrics responded to over 9,000 telephone and 2,200 written inquiries, and received over 600 visitors in 1971. The effort in this area alone required approximately 20-25 percent of the total man-years available for the Office.

8. ACTIVITIES UNDER SEC. 14(a): ACCIDENT INVESTIGATIONS

8.1 Collection of Accident Data

The Office of Flammable Fabrics has been actively searching for and identifying sources of information on the nature and extent of fabric flammability hazards faced by the American public. When potential sources have been identified, efforts were made to assist the people involved in the collection of data and to obtain their data for analysis and use by OFF.

8.1.1 Cooperation with HEW

OFF has continued to cooperate with the Department of Health, Education and Welfare to facilitate and ensure the collection of meaningful data on accidents involving flammable fabrics.

In the latter part of 1970, the Bureau of Product Safety, Food and Drug Administration, HEW instituted an accelerated data collection program using personnel in 17 regional districts. This new program lasted until mid-1971, during which time some 1000 case histories were transmitted to OFF by the FDA investigators, using a report form and instructions jointly developed by the Bureau of Product Safety and OFF. All these cases were screened as they were received by OFF for consistency of reporting and adherence to the guidelines and instructions provided to the investigators. OFF provided the Bureau of Product Safety with a detailed list of observations on the quality of the case histories received, to aid the FDA and its investigators in evaluating the program.

With the HEW/FDA accelerated flammable fabrics investigation program scheduled to terminate at mid-1971, the Department advised HEW of the continuing need for such

data and for the need for statistically valid sampling to permit development of estimates of the national picture. At the request of the National Advisory Committee, the Secretary again wrote the Secretary of HEW late in the year, to the effect that the investigations are of major importance to the proper implementation of the Act, and urged a high level of effort and random sampling. Secretary Richardson replied with assurances that a significant number of cases would be investigated and a national sampling system will be in operation shortly.

OFF provided FDA personnel with suggestions on ways in which new or continuing Bureau of Product Safety accident data collection programs could be made useful to the Department of Commerce Flammable Fabrics activities. Among these were OFF suggestions on how the new FDA National Electronic Injury Surveillance System (NEISS) could be modified to allow more adequate reporting and coding of flammable fabrics accidents.

During 1971, OFF established contacts with the Divisions of Health Interview Statistics, Vital Statistics, and Health Resources Statistics of the National Center for Health Statistics, in order to obtain more detailed information and reports on burns and other fire related injuries.

8.1.2 Cooperation with HEW Contractors

Early in 1971 OFF sent copies of documents describing the purpose and operation of its data system to the National Burn Information Exchange (NBIE) at the University of Michigan. Summaries of OFF test results of fabrics provided with NBIE case histories were periodically sent to FDA for transmittal to NBIE. In mid 1971 FDA provided OFF with a draft copy of an NBIE report titled "Flammable Clothing: Crisis in Burn Severity" which was helpful to OFF in setting priorities for future work.

In early 1971 OFF agreed with FDA to provide fiber characterizations and flammability test services to the Pittsburgh Burn Study (PBS), an FDA contractor at the University of Pittsburgh. PBS was to provide burn case investigation reports and fabrics recovered from fires investigated by them to OFF. The data from these case reports will be included in the OFF data base, but PBS encountered delays and had sent no fabrics nor reports by year's end.

8.1.3 Cooperation with Other Federal Agencies

During 1971 an informal arrangement was established for OFF to obtain information on flammable fabrics accident cases identified by the Federal Trade Commission (FTC). Under this arrangement FTC field personnel notify the nearest FDA regional investigator when a likely case is discovered by them. FDA investigates the case and transmits a report and any available fabric remnants to OFF for inclusion in its data system. As a part of its standing procedures, OFF tests the fabric remnants in its laboratories. Whenever a noncompliance with an applicable flammability standard is noted, for a material submitted from any source, FTC is notified immediately and proceedings are instituted by them to remove similar items from the market. In 1971 two such instances were reported to FTC.

In April 1971 OFF participated in a two-day conference of government representatives and others, convened by the Bureau of the Census, to discuss the needs for statistical data describing the fire service and possible use of such data by the fire service and other governmental or private agencies. Fire incidence and loss data requirements constituted major discussion topics at the conference.

Discussions were held with Department of Agriculture, Special Surveys personnel on the collection of market and other data on fabrics with flame retardant properties.

8.1.4 Cooperation with State and Local Governments

OFF has received the cooperation of fire officials in Kentucky; Brookhaven, New York; Prince Georges County, Maryland; Montgomery County, Maryland; and Washington, D.C. who provided reports on and samples of fabrics from specific fires in their jurisdictions. OFF made summaries of its tests on the fabric remnants available to these officials. In addition, Fire Marshals or other officials in all 50 states were contacted by OFF for data available in their states on the frequencies of fire injuries, relative to specific ignition sources and materials ignited. Approximately two-thirds had responded by year's end. Fire Marshals in several major cities were also contacted for similar data.

OFF assisted the Burns Care Institute, New York State Department of Health, in adapting a version of the OFF information processing system for use in the collection,

processing, and maintenance of burn injury statistics. The N.Y. Department of Health will provide OFF with summaries of its fire loss data.

8.1.5 Cooperation with Industry and Private Organizations

NBS was one of 18 sponsors (others included industrial trade associations, unions, federal agencies, retail chain stores, and safety oriented groups) of a six month-nationwide consumer study of household safety. The objective of the study, which was completed in the summer of 1971, was to obtain information on the non-occupational incidence of property damage or personal injuries associated with specific products (including fabrics other than as used in motor vehicles) or environmental conditions. OFF joined the on-going study and made tentative arrangements for collection of fabrics involved in fires mentioned by any of the 35,000 households interviewed in the study. None had been collected by year's end, from the fires that involved fabrics.

OFF participated in the National Fire Protection Association (NFPA) conference on the application and fire department utilization of the new NFPA Uniform Fire Incident Reporting System (UFIRS), with particular emphasis on how UFIRS could contribute data on the fabric fire problem.

Early in 1971 OFF staff visited the Shriners Hospitals for Crippled Children Burns Institute in Galveston, Texas. During the year OFF received a report from the Burns Institute summarizing data for patients admitted to their hospital during the March 1966 to December 31, 1970 period. This report was another source used to determine candidate priorities for future national fabric flammability standards.

8.2 Data Processing and Analysis

The Office of Flammable Fabrics has developed, maintains and operates the Flammable Fabric Accident Case and Testing System (FFACTS) to provide information and data on circumstances and factors in fabric fire cases. The system's capabilities were described in the annual report for 1970 [2], and the processing cycle for case histories was illustrated therein.

Data in the FFACTS computer master file were queried and subjected to statistical analyses to provide quantitative information on the relative frequencies of the involvement

of different fabric products, as well as qualitative information on trends and significant interrelationships. Such information was further analyzed and interpreted to develop candidate priorities for recommendations of standards for the flammability of fabric products; to provide the basis for the development of realistic tests which can discriminate between highly hazardous products and those of lower potential hazard; and to provide other insights into the many aspects of the flammable fabric problem.

9. ACTIVITIES UNDER SEC. 17:

NATIONAL ADVISORY COMMITTEE FOR THE FLAMMABLE FABRICS ACT

Section 17 of the Act states in part:

"(c) The Secretary shall consult with the National Advisory Committee before prescribing flammability standards or other regulations established under this Act."

Although this can be interpreted as defining a narrow and limited role for the Committee, the Committee has exercised a broader role. Two meetings of the full Committee were held during the year, and individual members and groups of members were involved frequently in informal discussions and consultation. The subjects of these discussions ranged over the entire spectrum of activities described in the preceding sections of this report. Members provided guidance and assistance in the development of standards and test methods, comments on the research tasks that would be most appropriate, leads to sources of data, and constructive criticism on the system established for extracting information from the data obtained. It is apparent that much of the interest shown by and the cooperation received from both industry and the consuming public were stimulated by the efforts of the members.

The original appointments of the members having expired at the end of 1970, the Secretary had to appoint a successor group. He reappointed for one year approximately half of the original members, in order to provide continuity, and essentially an equal number of new members. Representatives of manufacturers, distributors, and the consuming public were among both the reappointed and new members. The membership of the Committee and Department suffered the loss of one member through the sudden death of Mr. Morris Kaplan, Technical Director of Consumers Union, Inc. Mr. Kaplan had been a member throughout the Committee's existence. The loss of his valuable input to the Committee will be felt by everyone concerned with flammability standards.

Since two standards matters were very active at the end of the year, the Secretary decided it would be in the best public interest to retain the present members, who had great familiarity with the subjects and background, rather than replace some of them by new, comparatively uninformed individuals. Therefore, he reappointed all members whose appointments expired at the end of 1971.

10. CONCLUSIONS

A new flammability standard was established for children's sleepwear and proceedings were instituted for amending the standard to include sampling plans for materials and for garments. A proposed flammability standard was published for mattresses, and progress was made on the preparation of proposed flammability standards for blankets and for general wearing apparel.

A desirable improvement was made in the utility of the accident data base by completing computerization of the data, thereby facilitating the examination of this basis for determinations of need and the setting of priorities in research and test development. However, still lacking is a random sampling of accidents that would permit accurate extrapolation to national estimates of the overall fabric flammability problem.

The various activities at the National Bureau of Standards that are carried out in response to the Flammable Fabrics Act, the Fire Research and Safety Act of 1968, and fire research responsibilities in the organic act of NBS have been brought together under the coordination of the Manager of Fire Programs, thereby broadening the base of technical expertise and data that can be brought to bear on the overall fire problem.

Research was advanced by fundamental studies into the nature of combustion and the effectiveness of various chemicals on reducing the flammability of common textile materials, and by full scale studies of the life and property hazards that develop in a corridor as results of burnout of the contents of a connected room. The Department of Health, Education and Welfare, various trade associations, and the carpet industry have cooperated in and supported the latter study.

Liaison has been expanded with the public, voluntary standards groups, industry, and other government agencies at all levels.

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U. S. DEPARTMENT OF COMMERCE
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(Pages 14062-14073)

CHILDREN'S SLEEPWEAR**Notice of Standard**

On November 17, 1970, there was published in the *FEDERAL REGISTER* (35 F.R. 17670) a notice of finding that a flammability standard is needed for sleepwear normally worn by young children (5 years and under) to protect the public against unreasonable risk of the occurrence of fire leading to death, injury, or significant property damage. This notice preliminarily found that the proposed standard published in the same *FEDERAL REGISTER* was:

a. Needed for young children's sleepwear to protect the public against unreasonable risk of the occurrence of fire leading to death, personal injury, or significant property damage.

b. Reasonable, technologically practicable, and appropriate, and is stated in objective terms; and

c. Limited to young children's sleepwear, and fabrics or related materials which are intended to be used or which may reasonably be expected to be used in children's sleepwear, and which have been determined to present such unreasonable risk.

The comments received pursuant to the above-referenced publication, statements presented at the public hearings, and the reports of the National Advisory Committee for the Flammable Fabrics Act on the proposed children's sleepwear standard were reviewed and considered. Having made appropriate changes in the proposed standards for the flammability of young children's sleepwear based on those reviews and considerations and on further research, it is hereby found that the flammability standard as set out in full at the end hereof:

(a) Is needed for children's sleepwear to protect the public against unreasonable risk of fire leading to death, personal injury, or significant property damage;

(b) Is reasonable, technologically practicable and appropriate and is stated in objective terms; and

(c) Is limited to young children's sleepwear, and fabrics or related materials which are intended or promoted for use in children's sleepwear and which currently present the unreasonable risks specified in (a) above.

Intent and scope of standard. It is the intent of the standard set out in full at the end hereof to provide a high and effective level of protection to children approximately 5 years of age and younger against unreasonable risk of death or injury suffered as a result of ignition and continued burning of sleepwear garments, as defined in the standard, and/or as a result of the continued burning of

molten or other material falling or dripping from the burning garments. In consonance with the Act and Senate Report No. 407, 90th Congress, first session, this standard is expressly "tailored to meet the particular need or hazard shown to exist." It is therefore, limited to garments and fabrics intended or promoted for use in children's sleepwear without imposing the same requirement on all other wearing apparel. The regulation of fabrics intended for use in products other than children's sleepwear is not covered under this standard. Items in inventory or with the trade on the effective date of the standard are exempt. All concerned parties shall be required to maintain records that these items offered for sale after the effective date of this standard are eligible for the exemption.

The standard accomplishes the above objectives by limiting the individual and average char lengths of specimens subjected to 3-second impingement of a moderate sized flame, and by limiting the time after removal of the flame within which material fallen from the specimens may continue burning.

Effective date. The standard shall become effective for items manufactured 12 months from the date of promulgation. Normally under the Flammable Fabrics Act a standard becomes effective within 12 months following promulgation unless it is found for good cause shown that an earlier or later effective date is in the public interest. Some industry sources have stated that it is not technologically practicable to comply with the standard in less than 31-36 months. The Department's independent investigation shows, however, that it will be technologically practicable for the majority of companies to comply with the standard within 24 months from the date of promulgation and that some may be able to comply within 12 months. Accordingly, in order to conform with the requirements of the Act that the standard be technologically practicable, the standard is made effective 12 months after promulgation with a proviso temporarily requiring a permanent and conspicuous cautioning label for noncomplying goods manufactured during the 12 months after the effective date of the standard. All goods manufactured 24 months after promulgation are required to comply.

Effect on other standards. As of 12 months after the effective date of the standard, the present flammability standards under the Flammable Fabrics Act (Commercial Standard 191-53, Flammability of Clothing Textiles as modified by Act of Congress approved August 23, 1954, and Commercial Standard 192-53, General Purpose Vinyl Plas-

tic Film) are superseded insofar as they apply to items of children's sleepwear included in DOC FF 3-71. Nothing in this action affects the application of CS 191-53 and CS 192-53 to products, fabrics, or related materials not included in DOC FF 3-71.

Issued: July 27, 1971.

MAURICE H. STANS,
Secretary of Commerce.

CHILDREN'S SLEEPWEAR**STANDARD FOR THE FLAMMABILITY
OF CHILDREN'S SLEEPWEAR**

[DOC FF 3-71]

1. Definitions.
2. Scope and application.
3. General requirements.
4. Test procedure.
5. Labeling requirements.

1. **Definitions.** In addition to the definitions given in section 2 of the Flammable Fabrics Act, as amended (sec. 1, 81 Stat. 568; 15 U.S.C. 1191), and section 7.2 of the Procedures (33 F.R. 14642, Oct. 1, 1968), the following definitions apply for the purposes of this Standard:

(a) "Children's Sleepwear" means any product of wearing apparel up to and including size 6X, such as nightgowns, pajamas, or similar or related items, such as robes, intended to be worn primarily for sleeping or activities related to sleeping. Diapers and underwear are excluded from this definition.

(b) "Size 6X" means the size defined as 6X in Department of Commerce Voluntary Product Standard, previously identified as Commercial Standard, CS 151-50 "Body Measurements for the Sizing of Apparel for Infants, Babies, Toddlers, and Children."¹

(c) "Item" means any product of children's sleepwear, or any fabric or related material intended or promoted for use in children's sleepwear.

(d) "Trim" means decorative materials, such as ribbons, laces, embroidery, or ornaments. This definition does not include (1) individual pieces less than 2 inches in their longest dimension, provided that such pieces do not constitute or cover in aggregate a total of more than 20 square inches of the item, or (2) functional materials (findings), such as zippers, buttons or elastic bands, used in the construction of garments.

(e) "Acceptance Criterion" means the maximum char length and residual flame time which an item may exhibit in order to comply with this standard.

¹ Copies available from the National Technical Information Service, 5285 Port Royal Street, Springfield, VA 22151.

NOTICES

(f) "Char Length" means the distance from the original lower edge of the specimen exposed to the flame in accordance with the procedure specified in "4 Test Procedure" to the end of the tear or void in the charred, burned or damaged area, the tear being made in accordance with the procedure specified in 4(d)(2).

(g) "Residual Flame Time" is defined as the time from removal of the burner from the specimen to the final extinction of molten material or other fragments flaming on the base of the cabinet.

(h) "Afterglow" means the continuation of glowing of parts of a specimen after flaming has ceased.

2 *Scope and application.* (a) This Standard provides a test method to determine the flammability of items of children's sleepwear.

(b) All items of children's sleepwear must meet the acceptance criterion, except during the period set out in 5(b).

3 *General requirements.* (a) *Summary of test method.* Five conditioned specimens, 8.9 x 25.4 cm. (3.5 x 10 in.), are suspended one at a time vertically in holders in a prescribed cabinet and subjected to a standard flame along their bottom edge for a specified time under controlled conditions. The char length and residual flame time are measured.

(b) *Acceptance criterion.* An item meets the acceptance criterion if: (1) The average char length of five specimens does not exceed 17.8 cm. (7.0 in.), (2) no individual specimen has a char length of 25.4 cm. (10 in.), and (3) no individual specimen has a residual flame time greater than 10 seconds, when the testing is done in accordance with "4 Test Procedure".

4 *Test procedure.* (a) *Apparatus.* (1) *Test chamber.* The test chamber shall be a steel cabinet with inside dimensions of 30.5 cm. (12 in.) wide, 30.5 cm. (12 in.) deep, and 78.7 cm. (31 in.) high. It shall have a frame which permits the suspension of the specimen holder over the center of the base of the cabinet at such a height that the bottom of the specimen holder is 1.7 cm. (3/4 in.) above the highest point of the barrel of the gas burner specified in 4(a)(3) and perpendicular to the front of the cabinet. The highest point of the barrel of the gas burner shall be 17.5 cm. (6.9 in.) above the floor of the cabinet. The front of the cabinet shall be a close fitting door with a glass insert to permit observation of the entire test. The cabinet floor shall be covered with a piece of asbestos paper, whose length and width are approximately 2.5 cm. (1 in.) less than the cabinet floor dimensions and whose thickness is a nominal 0.3 cm. (1/8 in.). A piece of asbestos paper at least 15.2 x 15.2 cm. (6 x 6 in.) and of nominal thickness 0.15 cm. (3/16 in.) or less shall be used to catch the drips of other fragments and this latter paper shall be changed after each specimen which drips has been tested. The cabinet to be used in this test method is illustrated in Figure 1 and detailed in Engineering Drawings, Nos. 1 to 7.

(2) *Specimen holder.* The specimen holder is designed to permit suspension of the specimen in a fixed vertical position and to prevent curling of the specimen when the flame is applied. It shall consist of two U-shaped 0.32 cm. (1/8 in.) thick steel plates, 41.9 cm. (16.5 in.) long, and 8.9 cm. (3.5 in.) wide, with aligning pins. The openings in the plates shall be 35.6 cm. (14 in.) long and 5.1 cm. (2 in.) wide. The specimen shall be fixed between the plates, which shall be held together with side clamps. The holder to be used in this test method is illustrated in Figure 2 and detailed in Engineering Drawing No. 7.

(3) *Burner.* The burner shall be substantially the same as that illustrated in Figure 1 and detailed in Engineering Drawing No. 6. It shall have a tube of 1.1 cm. (0.43 in.) inside diameter. The input line to the burner shall be equipped with a needle valve. It shall have a variable orifice to adjust the height of the flame. The barrel of the burner shall be at an angle of 25° from the vertical. The burner shall be equipped with an adjustable stop collar so that it may be positioned quickly under the test specimen. The burner shall be connected to the gas source by rubber or other flexible tubing.

(4) *Gas supply system.* There shall be a pressure regulator to furnish gas to the burner under a pressure of 129±13 mm. Hg. (2 1/2±1/4 lbs. per sq. in.) at the burner inlet.

(5) *Gas.* The gas shall be at least 97 percent pure methane.

(6) *Hooks and weights.* Metal hooks and weights shall be used to produce a series of loads for char length determinations. Suitable metal hooks consist of No. 19 gauge steel wire, or equivalent, made from 7.6 cm. (3 in.) lengths of the wire, bent 1.3 cm. (0.5 in.) from one end to a 45° angle hook. The longer end of the wire is fastened around the neck of the weight to be used and the other in the lower end of each burned specimen to one side of the burned area. The requisite loads are given in Table 1.

TABLE 1

Original fabric weight ¹		Loads	
g./sq. m.	(oz./sq. yd.)	g	(lb.)
Less than 101.....	(Less than 3.0).....	64.4	(0.12)
101-207.....	(3.0-6.0).....	113.4	(0.25)
207-338.....	(6.0-10.0).....	226.8	(0.50)
Greater than 338.....	(Greater than 10.0).....	340.2	(0.75)

¹ Weight of the original fabric, containing no seams or trim, is calculated from the weight of a specimen which has been conditioned for at least 8 hours at 21±1.1° C. (70±2° F.) and 65±2 percent relative humidity. Shorter conditioning times may be used if the change in weight of a specimen in successive weighings made at intervals of not less than 2 hours does not exceed 0.2 percent of the weight of the specimen.

(7) *Stopwatch.* A stopwatch or similar timing device shall be used to measure time to 0.1 second.

(8) *Scale.* A linear scale graduated in mm. or 0.1 in. divisions shall be used to measure char length.

(9) *Circulating air oven.* A forced circulation drying oven capable of maintaining the specimens at 105±2.8° C.

(221±5° F.), shall be used to dry the specimen while mounted in the specimen holders.²

(10) *Desiccator.* An air-tight and moisture-tight desiccating chamber shall be used for cooling mounted specimens after drying. Anhydrous silica gel shall be used as the desiccant in the desiccating chamber.

(11) *Hood.* A hood or other suitable enclosure shall be used to provide a draft-free environment surrounding the test chamber. This enclosure shall have a fan or other suitable means for exhausting smoke and/or toxic gases produced by testing.

(12) *Sewing machine.* A machine capable of carrying out the operations in 4(b)(2) shall be used whenever sewing is required.

(b) *Specimens and sampling.* (1) *Fabric.* Select a sample of the item representative of the lot and large enough to permit cutting five specimens. Pretesting shall be performed to determine whether different results are obtained for specimens cut with their long dimensions in the machine or cross-machine directions; if different results are obtained, the official test specimens shall be cut such that they are tested in the direction that gives the greater flammability.

Cut five specimens 8.9 x 25.4 cm. (3.5 x 10 in.) from the fabric sample selected. If the sample is wrinkled, it may be ironed. If possible, specimens shall be cut so that each contains different machine direction yarns and different cross-machine direction yarns.

(2) *Garments.* Select a sample garment representative of the lot and large enough to permit cutting five specimens. More than one item of that lot may be used if necessary to obtain the five specimens. Cut five specimens 8.9 x 25.4 cm. (3.5 x 10 in.). If the garment is wrinkled, it may be ironed. Seamed and trimmed areas shall be tested, with the exception of the small areas indicated in section 1(d). Specimens shall be cut such that the seam or trim is down the center of the long dimension of the specimen. For items in which the trim or seam length is less than 25.4 cm. (10 in.), specimens shall be cut with the seam beginning at the lower edge of each specimen.

For items with attached trim whose configuration does not allow placement in the specimen holder as described above, specimens shall be prepared by sewing or attaching the trim to the center of the vertical axis of an appropriate sample of untrimmed fabric chosen from another portion of the item, beginning the sewing or attachment of the lower edge of each specimen. The sewing or attachment shall be made in

² Option 1 of ASTM D2654-87T, "Method of Test for Amount of Moisture in Textile Materials", describes a satisfactory oven. (1970 Book of ASTM Standards, Part 24, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

NOTICES

the manner in which trim was attached in the item. This trim shall be removed from the item with due care to avoid damage to the trim; all remnants of thread, other fastening material and base fabric shall be removed from the trim. Sewing or otherwise attaching the trim shall be done with thread or fastening material of the same (or as close to the same as possible) composition and size as used for this purpose in the original item and using the same (or as close to the same as possible) stitching and seam type. The trim shall be sewed the entire length (if possible) of representative samples of the item.

Alternatively, the set of five specimens may be prepared from the base fabric and other component materials used in a garment rather than by cutting the finished garment. The base fabric specimens shall be cut or prepared with the long dimension in the more flammable direction. The seams to be used in the garment shall be sewn, attaching two pieces of fabric, so that each seam lies along the long center line of a resulting test specimen. The same type and composition of sewing thread as will be used in the garment shall be used in preparing the test specimens. The trim to be used in the garment shall be sewn or attached to the center of the vertical axis of a fabric specimen beginning the sewing or attachment at the lower edge of the specimen. Sewing or otherwise attaching the trim shall be done the entire length of the fabric specimen with thread or fastening material of the same composition and size as will be used in the garment and using the same stitching and seam type. In both instances (trim and seam), the method of preparing the seam or attaching the trim to each test specimen shall be the same as that to be used in the finished garment.

(c) *Mounting and conditioning of specimens.* The specimens shall be placed in specimen holders so that the bottom edge of each specimen is even with the bottom of the specimen holder. Mount the specimen in as close to a flat configuration as possible. The sides of the specimen holder shall cover 1.9 cm. ($\frac{3}{4}$ in.) of the specimen width along each long edge of the specimen, and thus shall expose 5.1 cm. (2 in.) of the specimen width. The sides of the specimen holder shall be clamped with a sufficient number of clamps or shall be taped to prevent the specimen from being displaced during handling and testing. The specimens may be taped in the holders if the clamps fail to hold them. Place the mounted specimens in the drying oven in a manner that will permit free circulation of air at 105° C. (221° F.) around them for 30 minutes.*

Remove the mounted specimens from the oven and place them in the desiccator for 30 minutes to cool. No more than five specimens shall be placed in a desiccator at one time. Specimens shall remain in the desiccator no more than 60 minutes.

(d) *Testing—(1) Burner adjustment.* With the hood fan turned off, use the needle valve to adjust the flame height of the burner to 3.8 cm. ($1\frac{1}{2}$ in.) above the highest point of the barrel of the burner. A suitable height indicator is shown in Engineering Drawing 6 and Figure 1.

(2) *Specimen burning and evaluation.* One at a time, the mounted specimens shall be removed from the desiccator and suspended in the cabinet for testing. The cabinet door shall be closed and the burner flame impinged on the bottom edge of the specimen for 3.0 ± 0.2 seconds.† Flame impingement is accomplished by moving the burner under the specimen for this length of time, and then removing it.

If flaming drips or fragments are evident, measure the residual flame time to the nearest 0.1 second. If an individual specimen produces fragments or drips which are flaming beyond the specified 10-second residual flame time, that item fails to meet the acceptance criterion and testing of that item may be stopped.

When afterglow has ceased, remove the specimen from the cabinet and holder, and place it on a clean flat surface. Fold the specimen lengthwise along a line through the highest peak of the charred or melted area; crease the specimen firmly by hand. Unfold the specimen and insert the hook with the correct weight as shown in Table 1 in the specimen on one side of the charred area 6.4 mm ($\frac{1}{4}$ in.) from the lower edge. Tear the specimen by grasping the other lower corner of the fabric and gently raising the specimen and weight clear of the supporting surface.‡ Measure the char length as the distance from the end of the tear to the edge of the specimen exposed to the flame. If the char length of any individual specimen of an item equals 25.4 cm (10 in.) that item fails to meet the acceptance criterion and testing may be stopped. After testing each specimen, vent the hood and cabinet to remove the smoke and/or toxic gases.

(3) *Report.* Report the value of char length, in centimeters (inches), and the residual flame time, in seconds, for each specimen, as well as the average char length for the set of five specimens.

(4) *Laundrying.* The procedures described under 4(b), 4(c), and 4(d) shall be carried out on finished items (as produced or after one washing and drying) and after they have been washed

and dried 50 times* according to Test Method AATCC 124-1969.† Items which do not withstand 50 laundryings shall be tested at the end of their useful service life. Washing procedure 6.2(III), with a water temperature of $60 \pm 2.8^\circ$ C. ($140 \pm 5^\circ$ F.), and drying procedure 6.3.2 (B), shall be used. Maximum load shall be 3.64 Kg. (8 pounds) and may consist of any combination of test samples and dummy pieces. Alternatively, a different number of times under another washing and drying procedure may be specified and used, if that procedure has previously been found to be equivalent by the Federal Trade Commission.

Such laundrying is not required of items which are not intended to be laundryed, as determined by the Federal Trade Commission.

Items which are not susceptible to being laundryed and are labeled "dry-clean only" shall be dry-cleaned by a procedure which has previously been found to be acceptable by the Federal Trade Commission.

For the purpose of the issuance of a guarantee under section 8 of the Act, finished sleepwear garments to be tested according to 4(b)(2) need not be laundryed or dry-cleaned provided all fabrics used in making the garments (except trim) have been guaranteed by the fabric producer to meet the acceptance criterion after such laundrying or dry-cleaning.

5 *Labeling requirements—(a) Care labels.* All items of children's sleepwear shall be labeled with precautionary instructions to protect the items from agents or treatments which are known to cause deterioration of their flame resistance. If the item has been initially tested under 4(d)(4) after one washing and drying, it shall be labeled with instructions to wash before wearing. Such labels shall be permanent and otherwise in accordance with rules and regulations established by the Federal Trade Commission.

(b) *Temporary requirement for non-complying items.* Items of noncomplying children's sleepwear which are manufactured during the 12 months following the effective date of the standard shall, prior to introduction into commerce, be prominently, permanently, and conspicuously labeled with the following statement: "Flammable (Does Not Meet U.S. Department of Commerce Standard DOC FF 3-71.) Should not be worn near sources of fire." Such labels should be in accordance with the rules and regulations established by the Federal Trade Commission.

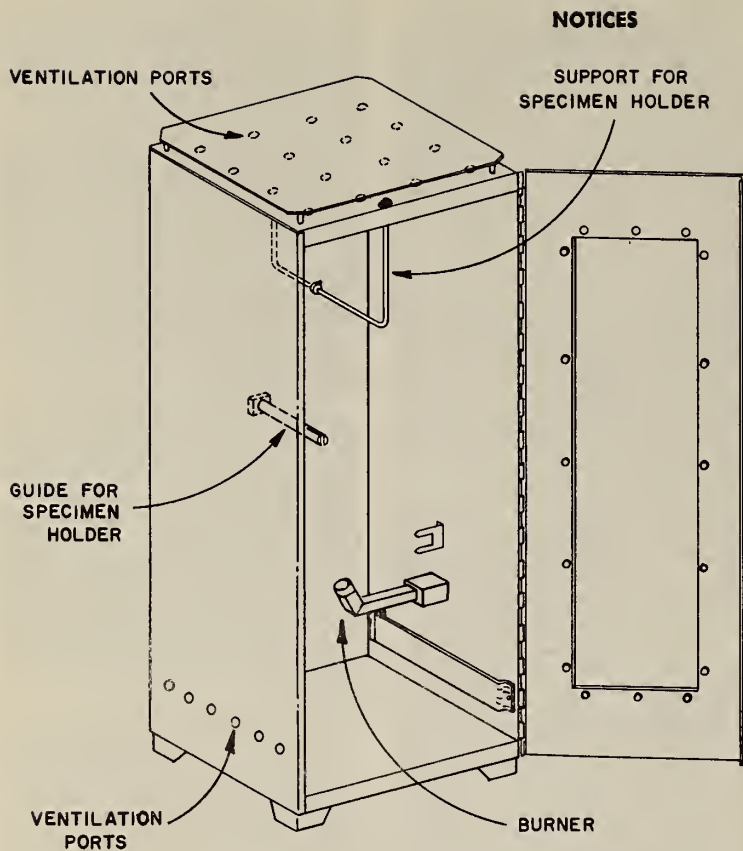
* If changes in an item occur during laundrying which appear to affect the flammability of that item sufficiently to make it fail the acceptance criterion, that item may be tested after fewer than 50 laundryings. If the item fails, further laundryings are not necessary.

† Technical Manual of the American Association of Textile Chemists and Colorists, Vol. 46, 1970, published by AATCC, Post Office Box 12215, Research Triangle Park, NC 27709.

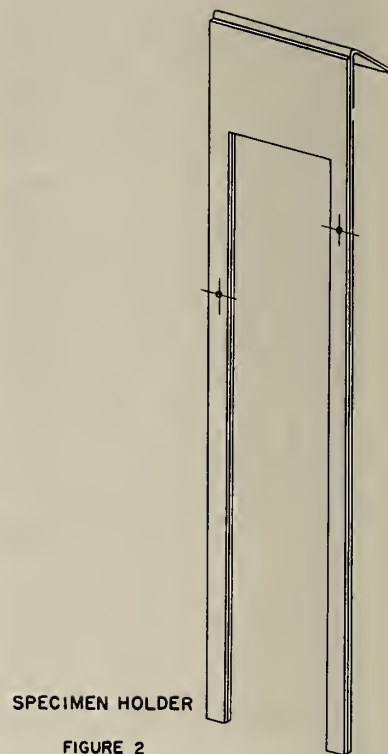
* If the specimens are moist when received, permit them to air-dry at laboratory conditions prior to placement in the oven. A satisfactory preconditioning procedure may be found in ASTM D 1776-67, "Conditioning Textiles and Textile Products for Testing", ("1970 Book of ASTM Standards", Part 24, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

† If more than 15 seconds elapse between removal of a specimen from the desiccator and the initial flame impingement, that specimen shall be reconditioned prior to testing.

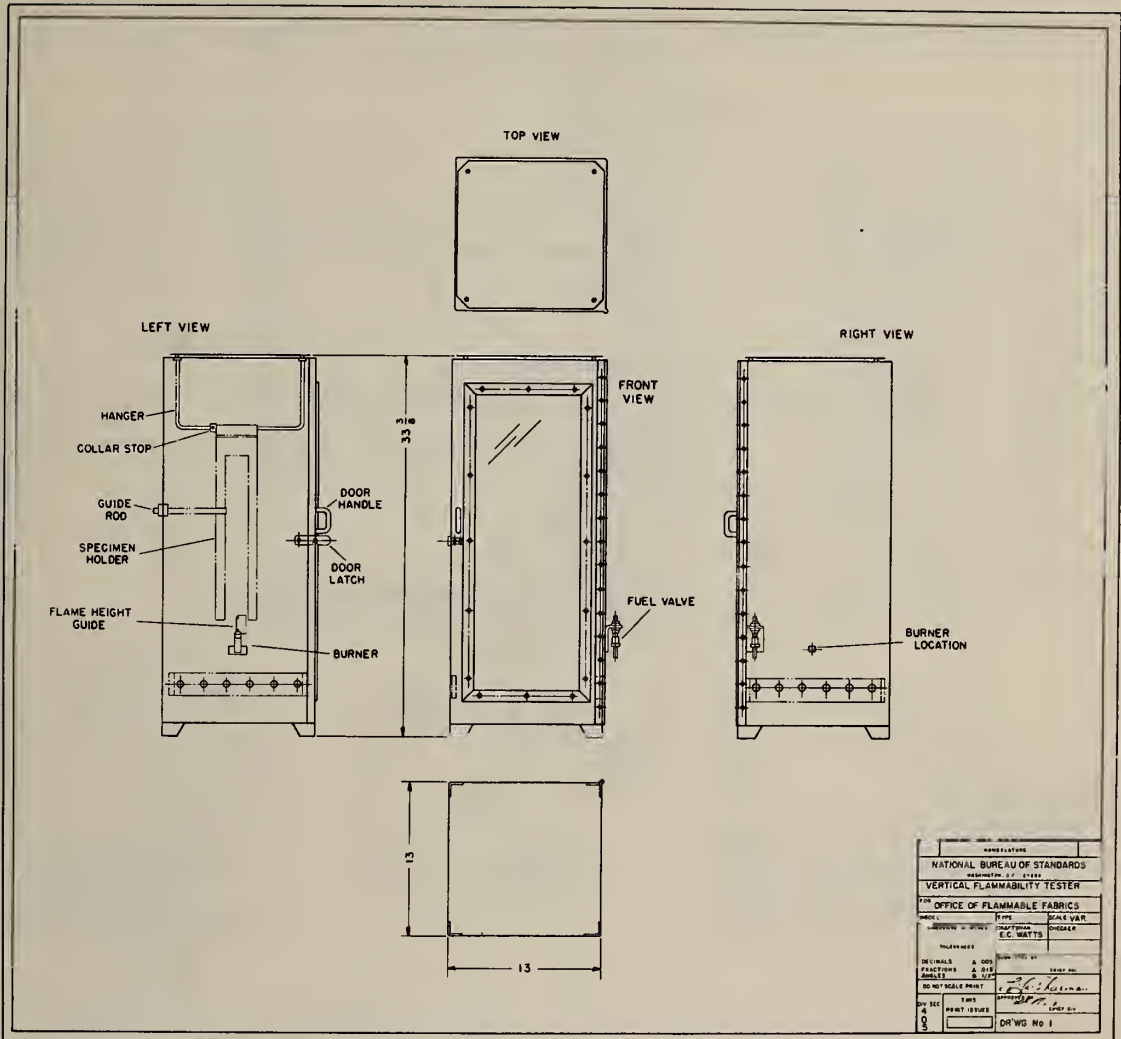
‡ A figure showing how this is done is given in AATCC 34-1969, Technical Manual of the American Association of Textile Chemists and Colorists, Vol. 46, 1970, published by AATCC, Post Office Box 12215, Research Triangle Park, NC 27809.



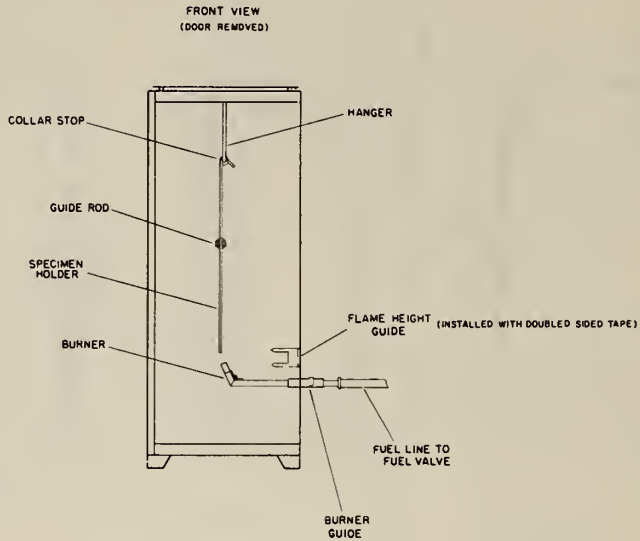
VERTICAL TEST CABINET
FIGURE 1



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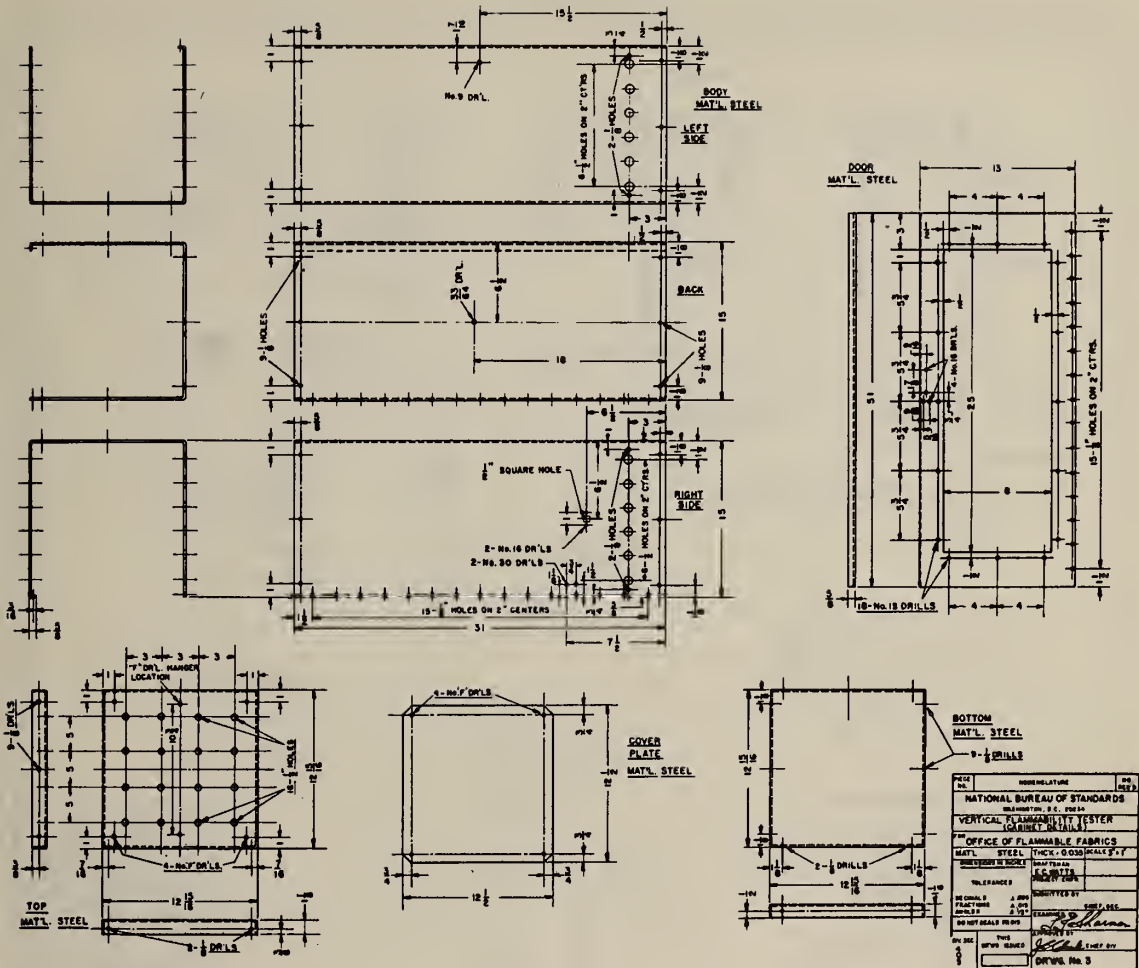


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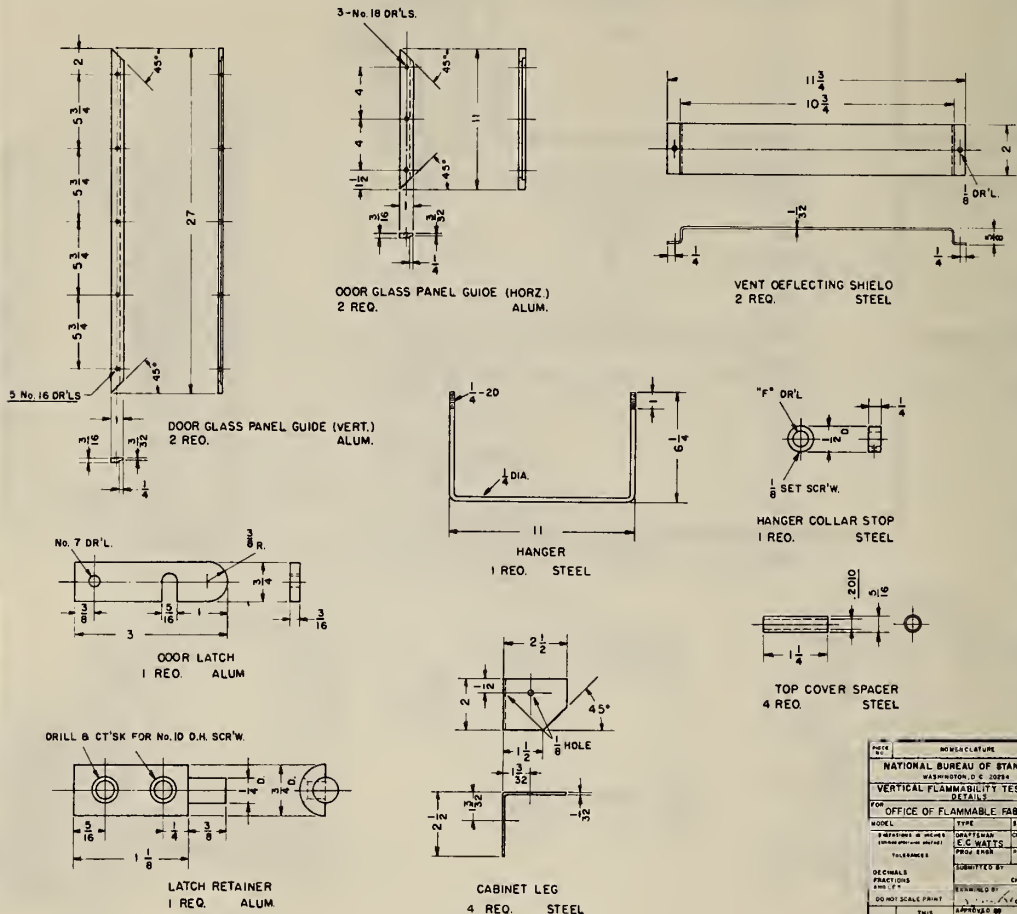


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VERTICAL FLAMMABILITY TESTER			
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OFFICE OF FLAMMABLE FABRICS			
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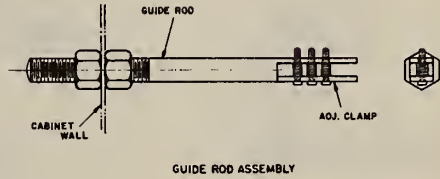
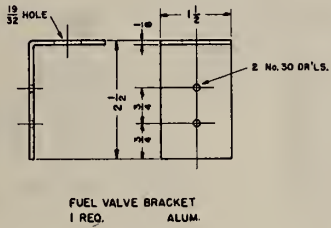
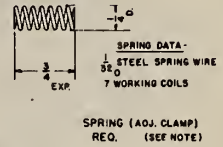
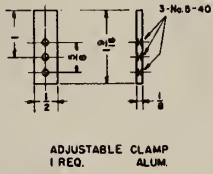
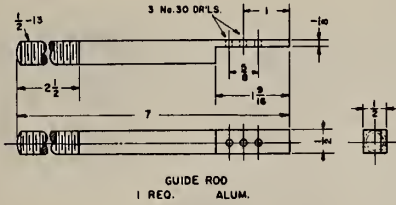


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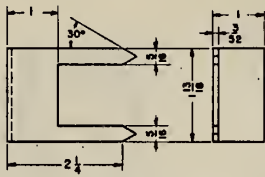
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FOR OFFICE OF FLAMMABLE FABRICS	
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DECIMALS FRACTIONS	PREP. ERM
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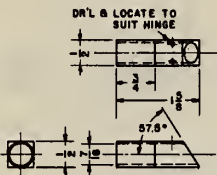


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OF FLAMMABLE FABRICS		
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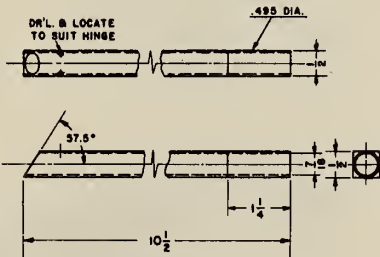
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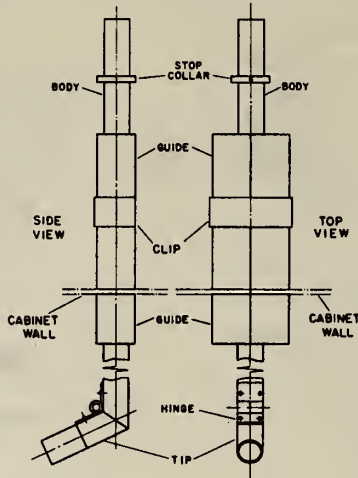
FLAME HEIGHT GUIDE
I REQ. STEEL



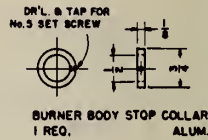
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I-REQ. STEEL



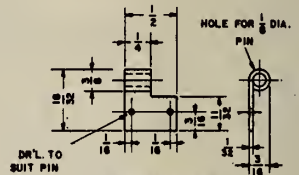
BURNER BODY	
1 REO.	ALUM.



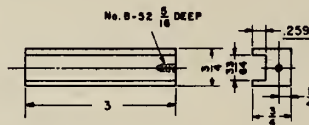
BURNER ASSEMBLY



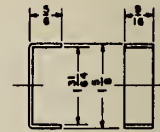
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1 REQ. ALUM.



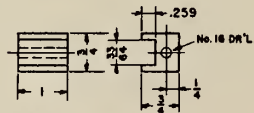
BURNER BODY HINGE
2 REQ. BRASS



BURNER BODY GUIDE (I.S.)
2 REQ. ALUM.



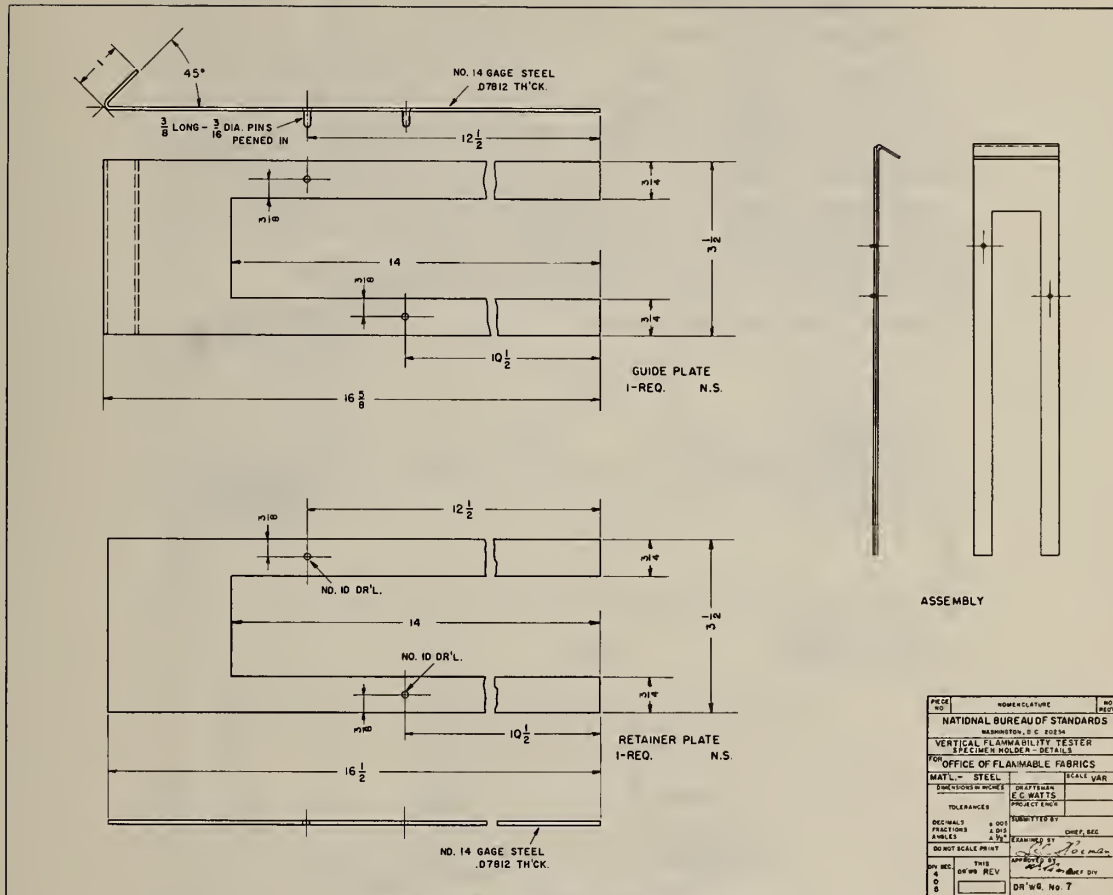
GUIDE CLIP	
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BURNER BODY GUIDE (0.5.)
2 REQ. ALUM.

PG# NO.	NAME/CLATURE		MR. NO.
NATIONAL BUREAU OF STANDARDS			
WASHINGTON, D. C. 20540			
OFFICIAL PLACABILITY TESTER			
ITEMS			
VEHICLE OF FLAMMABLE FABRICS			
MAT. -	TYPE -	THICKNESS -	VEH. -
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TOLERANCE I			
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PRACTICE	0.000	STANDARD	CHG. SEC.
ANALYSIS	0.125	STANDARD	
DO NOT SCALE POINT			
DOV. REC.	TWO	APPROVED BY	
0	DR. W. G. 1862		
0		DR. W. G. No. 6	

NOTICES



[FR Doc.71-10925 Filed 7-28-71;9:16 am]

DEPARTMENT OF COMMERCE

Office of the Secretary

CHILDREN'S SLEEPWEAR

Notice of Standard; Correction

In F.R. Doc. 71-10925 appearing at pages 14062-14073 in the issue for Thursday, July 29, 1971, the following nonsubstantive corrections are made:

In paragraph .4(a)(1) of the Standard for the Flammability of Children's Sleepwear (Doc. FF 3-71) on page 14063, in the first sentence, after the words "dimensions of" delete the remainder of the sentence and substitute

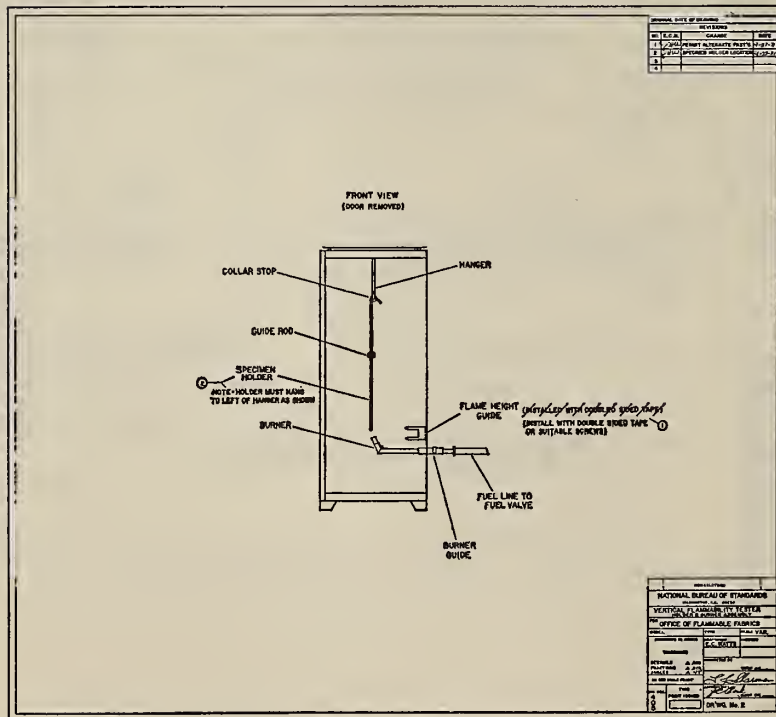
the following, "32.9 cm. ($12\frac{15}{16}$ in.) wide, 32.9 cm. ($12\frac{15}{16}$ in.) deep, and 76.2 cm. (30 in.) high."

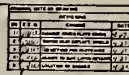
In paragraph .4(a)(2) on page 14064, delete the second sentence in the paragraph and substitute the following sentence in lieu thereof, "It shall consist of two U-shaped 0.20 cm. (14 ga USS) thick steel plates, 42.2 cm. ($16\frac{5}{8}$ in.) long, and 8.9 cm. (3.5 in.) wide, with aligning pins."

On pages 14068, 14069, 14070, 14071, and 14072, delete Drawings Nos. 2, 3, 4, 5, and 6 respectively and substitute therefor the hereto attached Drawings Nos. 2, 3, 4, 5, and 6.

Issued: November 4, 1971.

MAURICE H. STANS,
Secretary of Commerce.





DEPARTMENT OF COMMERCE

Office of the Secretary

[15 CFR Part 7]

MATTRESSES

Proposed Flammability Standard

On June 10, 1970, there was published in the *FEDERAL REGISTER* (35 F.R. 8944) a notice of finding that a flammability standard or standards, or other regulations, including labeling, may be needed for mattresses, used either alone or as a component of a bedding assembly, and fabrics or related materials intended to be used, or which may reasonably be expected to be used, in these products. This finding informed the public that a standard may be needed to protect the public against unreasonable risk of the occurrence of fire leading to death or personal injury or significant property damage from mattress fires and instituted proceedings for the development of an appropriate flammability standard or standards, or other regulation, including labeling, for mattresses.

After review and analysis of the comments received, analysis of information developed through research, and after further review of information cited in the June 10, 1970, *FEDERAL REGISTER* (35 F.R. 8944), and more recent additions thereto, it is hereby found that a flammability standard for mattresses is needed to protect the public against unreasonable risk of the occurrence of fire leading to death, injury, or significant property damage arising from such hazards as continuous slow burning or smoldering and the resultant production of smoke or toxic atmospheres.

Proposed standard. It is preliminarily found that the proposed flammability standard DOC PFF 4-71, the Flammability Standard for Mattresses, as set out in full at the end hereof as appendix I:

(a) Is needed for mattresses to protect the public against unreasonable risk of the occurrence of fire arising from such hazards as continuous slow burning or smoldering and the resultant production of smoke or toxic atmosphere leading to death, personal injury, or significant property damage;

(b) Is reasonable, technologically practicable, and appropriate and is stated in objective terms; and

(c) Is limited to mattresses and mattress pads, which have been determined to present such unreasonable risk.

Basis for proposed flammability standard. The finding that a flammability standard or other regulation is needed for mattresses is based on reported accident data and on the results of laboratory research. Data on building fires in recent years dramatically underscore the fact that no national flammability standard now exists for mattresses which affords protection to the general public from unreasonable risks of death, injury, or significant property damage due to fires. Mattresses may be produced and made available for consumer purchase, which, when used alone or in a bedding

assembly, present through ordinary use such hazards as continuous slow burning or smoldering with the resultant production of injurious smoke or toxic atmospheres.

Data supporting the foregoing conclusions were contained in the above-cited notice published in the *FEDERAL REGISTER* on June 10, 1970. In addition to the data contained in that notice, the March 1971 issue of "Fire Journal" contains a report of 1969 Oregon and California fires which states that in cases where the first material to ignite was known, bedding or mattresses ignited first in 13.7 percent of the 3,126 Oregon residential fires and produced 24 percent of the 285 Oregon residential fire casualties. When fires which involved flammable liquids or gases and energized electrical equipment were excluded from this group of 1969 Oregon fires, the initial ignition of bedding or mattresses accounted for over 20 percent of the residential fires and over 34 percent of the residential fire casualties. In the State of California, the initial ignition of bedding or mattresses by smoking occurred in 18.4 percent of the 435 fire deaths.

By June 1, 1971, the Department of Commerce had analyzed data from 1,005 cases involving the burning of products composed of fabrics or related materials which had been investigated by the Department of Health, Education, and Welfare. Seventy-six were cases in which mattresses were involved. Over 60 percent of these fires, which produced injuries to 28 and death to six, were caused by smoking in bed. In another analysis, data on fires in the city of Washington, D.C., during the period of April through June 1971, showed that 11.7 percent of 915 building fires involved the ignition of mattresses.

All the data cited above and in the June 10, 1970, notice in the *FEDERAL REGISTER* show the high incidence of fires resulting from mattress or bedding ignitions. Laboratory research indicates that a smoldering mattress is a major source of injurious smoke or toxic atmospheres. It has also been determined that burning cigarettes are the principal ignition source for mattress fires which result in the production of injurious smoke toxic atmospheres. Thus, the proposed standard for mattresses specifies cigarettes as the ignition source. Further laboratory research, using cigarettes as the ignition sources and mattresses representing current production, indicates that the addition of sheets on the mattress increases the probability of ignition of the mattress. Accordingly, sheets are included in the testing procedure in the proposed standard.

Finally, as the result of this research and analysis conducted at the National Bureau of Standards and an interlaboratory evaluation of the test procedures in cooperation with the American Society for Testing and Materials, the National Association of Bedding Manufacturers, and other producers, retailers, and consumer groups, it has been concluded that the test method contained in the proposed standard is reasonable and appropriate.

Participation in proceedings. All interested persons are invited to submit written comments relative to the proposed flammability standard within 30 days after the date of publication of this notice in the *FEDERAL REGISTER*. Written comments should be submitted in at least four (4) copies to the Assistant Secretary for Science and Technology, Room 3862, U.S. Department of Commerce, Washington, D.C. 20230, and may include any data or other information pertinent to the subject.

Inspection of relevant documents. The written comments received pursuant to this notice will be available for public inspection at the Central Reference and Records Inspection Facility of the Department of Commerce, Room 7046, (Department Library) Main Commerce Building, 14th Street between E Street and Constitution Avenue NW., Washington, DC 20230.

Two supporting documents are available for inspection in the above facility. One, "Accident Data and Research on Hazards from Mattress Fires" presents an analysis of accident data on fires involving mattresses, and on the results of research on the hazards from ignition and continuous burning of mattresses and the resultant production of smoke or toxic atmosphere. The second, "Flammability Test: Analysis of Interlaboratory Results," presents the results and a statistical analysis of the interlaboratory evaluation.

Issued: September 3, 1971.

JAMES H. WAKELIN, Jr.,
Assistant Secretary
for Science and Technology.

MATTRESSES

PROPOSED FLAMMABILITY STANDARD FOR
MATTRESSES

[DOC PFF 4-71]

1. Definitions.
2. Scope and application.
3. General requirements.
4. Test procedure.
5. Laundering.
6. Sampling plans.
7. Labeling.

1. **Definitions.** In addition to the definitions given in section 2 of the Flammable Fabrics Act as amended (sec. 1, 81 Stat. 568; 15 U.S.C. 1191) and § 7.2 of the procedures (33 F.R. 14642, Oct. 1, 1968), the following definitions apply for the purpose of this standard:

(a) "Mattress" means a ticking filled with a resilient material used alone or in combination with other products and intended or promoted for sleeping upon. This definition includes mattress pads and excludes pillows and boxsprings.

(b) "Acceptance criteria" means that set of ignition properties which a mattress must exhibit in order to comply with this standard.

(c) "Ticking" means the outermost layer of fabric or related material, that encloses the mattress core and upholstery materials.

(d) "Core" ("Unit") means the main support system of the mattress, such as springs or foam.

(e) "Upholstery material" means all

material, either loose or attached, between the tickings or between the ticking and the core of the mattress, if a core is present.

(f) "Tape edge" ("Edge") means the seam or border edge of a mattress.

(g) "Quilted" means sewn through or otherwise attached to ticking and one or more layers of upholstery material.

(h) "Tufted" means buttoned or laced through the ticking and upholstery materials and/or core.

2. *Scope and application.* (a) This standard provides a test method to determine the ignition resistance of a mattress when exposed to a lighted cigarette.

(b) All types of mattresses, regardless of their method of fabrication or material content, must meet the acceptance criteria.

3. *General requirements.*—(a) *Summary of test method.* The method involves the exposure of each type of mattress surface to a lighted cigarette as the standard igniting source in a draft-protected environment and the measurement of the ignition resistance of the mattress in terms of nonignition (N) or ignition (I). These surfaces include smooth, tape, and quilted or tufted locations, if they exist on the mattress surfaces. If nonignition results are obtained for all bare mattress tests, then two-sheet tests are conducted over similar surface locations. In the latter test the burning cigarette is placed between the sheets, and nonignition or ignition results are recorded. Mattresses which contain fire retardant treated components must be wet down with water and dried prior to testing.

(b) *Acceptance criteria.* Testing the mattress in accordance with the testing procedure set forth in "4 Test Procedure," a mattress meets the acceptance criteria if:

(1) Five minutes after any cigarette has completely burned out on the mattress surface, all smoking has stopped, and examination of the exposed area shows no evidence of ignition or continuing combustion, and

(2) Char length on the mattress surface is not more than one inch in any direction from any cigarette.

4. *Test procedure.*—(a) *Apparatus.*—

(1) *Test room.* The test room shall be large enough to accommodate a full size mattress in a horizontal position and to allow for free movement of personnel and air (without draft) around the test specimen. The room shall be equipped with a support system (platform, bench, etc.) upon which a mattress may be placed in a horizontal position at a reasonable height for making observations. The test room shall be draft-protected and equipped with a suitable system for exhausting smoke and/or noxious gases produced by testing. The test room atmospheric conditions shall be between 18°–27° C. (65°–80° F.) and at less than 55 percent relative humidity.

(2) *Ignition source.* The ignition source shall be cigarettes without filter tips made from 100 percent natural tobacco, 85±2mm. long with a tobacco packing density of 0.270±0.020 g./cm.³.

(3) *Fire extinguisher.* A pressurized water fire extinguisher, or other suitable fire extinguishing equipment, shall be immediately available.

(4) *Water bottle.* A water bottle fitted with a spray nozzle shall be used to extinguish the ignited portions of the mattress.

(5) *Scale.* A linear scale graduated in millimeters or 0.1-inch divisions shall be used to measure char length.

(6) *Other apparatus.* In addition to the above, a timer, a thermometer, a relative humidity measuring instrument, a knife, and tongs are required to carry out the testing.

(b) *Specimens and sampling.*—(1) *Selection of mattress sample.* The mattress selected for test shall be a complete and finished product, representative of such mattresses produced for sale.

(2) *Preparation of mattress samples.* The mattress shall be divided laterally into two sections (see Figure 1), one section for the bare mattress tests and the other for the two-sheet tests. If a mattress contains any fire retardant treated components it shall be soaked with water and dried prior to testing. Uniformly wet the mattress using no less than 2 gallons of water for each foot of width. Prior to conditioning, air dry the mattress for at least 48 hours at an ambient temperature above 18° C. (65° F.) and a relative humidity below 55 percent.

(3) *Sheet selection.* The sheet shall be white, 100 percent combed cotton percale, with 180 threads per square inch. Size of sheet shall be appropriate for the mattress being tested.

(4) *Sheet preparation.* The sheets shall be laundered before use by the procedure prescribed in Method 124—1967 of the American Association of Textile Chemists and Colorists washing procedure 6.2 (III), with a water temperature of 60°±2.8° C. (140°±5° F.), drying procedure 6.3.2(B). Maximum load shall be 3.64 kg. (8 pounds) and may consist of any combination of sheets and dummy pieces. The hems shall be cut from the sheet and the sheet then cut across the width into two equal parts.

(5) *Cigarettes.* An unopened package of cigarettes shall be selected for each mattress evaluation.

(c) *Conditioning.* The mattresses, sheets, and cigarettes shall be conditioned at a temperature of 18°–27° C. (65°–80° F.) and a relative humidity less than 55 percent for at least 48 hours prior to test. The cigarettes shall be removed from the package and supported in a suitable manner to permit free movement of air around them during conditioning.

(d) *Testing.*—(1) *General.*—a. Light and place one cigarette at a time on the mattress surface. (If previous experience with the same type of mattress has indicated that rapid spread of combustion is not likely, up to three cigarettes may be lighted and placed on the mattress at one time.) If more than one cigarette is burning at one time, the cigarettes must be positioned no less than 6 inches apart on the mattress surface. The cigarette used as the ignition source shall be well lighted but not burned

more than 4mm. (0.16 in.) when placed on the mattress. Fire extinguishing equipment must be readily available at all times.

b. If a cigarette extinguishes before burning its full length, the test is considered "no test" and must be repeated with a freshly lit cigarette on a different portion of the same type of location on the mattress.

c. Three cigarettes shall be burned on each of the different mattress locations: Smooth surface, tape edge, and quilted or tufted areas, if they exist in the particular mattress under test.

d. If, during the testing, the mattress fails at any time to meet the acceptance criteria the testing may be stopped.

(2) *Bare mattress test.*—a. *Smooth surfaces.* Each of three burning cigarettes shall be placed directly on a smooth surface location on the test mattress on the half reserved for bare mattress tests. The cigarettes should burn their full lengths on a smooth surface without burning across a tuft or stitching of a quilted area. However, if this is not possible because of mattress design, then the cigarettes shall be positioned on the mattress in a manner which will allow as much of the butt ends as possible to burn on smooth surfaces. Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

CAUTION: Even Under the Most Carefully Observed Conditions, Smoldering Combustion Can Progress to the Point Where It Cannot Be Readily Extinguished. It Is Imperative That a Test Be Discontinued as Soon as Ignition Has Definitely Occurred. Immediately Wet the Exposed Area With a Water Spray (From Water Bottle), Cut Around the Burning Material With a Knife and Pull the Material Out of the Mattress With Tongs. Make Sure That All Charred or Burned Material Is Removed. Ventilate the Room.

b. *Tape edge.* Each of three burning cigarettes shall be placed in the depression between the mattress top surface and the tape edge, parallel to the tape edge on the half of the test mattress reserved for bare mattress tests. If there is no depression at the edge, hold the cigarettes in place along the edge and parallel to the edge with straight pins. Three straight pins may be inserted through the edge at a 45° angle such that one pin supports the cigarette at the top, one at the center, and one at the butt. The heads of the pins must be below the upper surface of the cigarette (see Figure 2). Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

c. *Quilted location.* If quilting exists on the test mattress, each of three burning cigarettes shall be placed on quilted locations of the test mattress. The cigarettes shall be positioned directly over the thread in the depression created by the quilting process on the half of the test mattress reserved for bare mattress tests. If the quilt design is such that the cigarettes cannot burn their full lengths over the thread, then the cigarettes shall be positioned in a manner which will allow as much of the butt ends as possible to burn on the thread. Report results for each cigarette as nonignition (N) or ignition (I) as defined in the

acceptance criteria.

d. *Tufted location.* If tufting exists on the test mattress, each of three burning cigarettes shall be placed on tufted locations of the test mattress. The cigarettes shall be positioned so that they burn down into the depression caused by the tufts and so that the butt ends of the cigarettes burn out over the buttons or laces used in the tufts on the half of the test mattress reserved for bare mattress tests. Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

(3) *Two-sheet tests.* Spread a section of sheet material smoothly over the mattress surface and tuck under the mattress on the second half of the test mattress, which has been reserved for the two-sheet test.

a. *Smooth surfaces.* Each of three burning cigarettes shall be placed directly on the sheet covered mattress in a smooth surface location as defined in the bare mattress test. Immediately cover the first sheet and the burning cigarettes loosely with a second, or top, sheet (see Figure 2). Do not raise or lift the top sheet during testing unless obvious ignition has occurred. If ignition occurs, immediately remove the sheets and cigarette and follow the cautionary procedures outlined in the bare mattress test. Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

b. *Tape edge.* Each of three burning cigarettes shall be placed in the depression between the top surface and the tape edge on top of the sheet, and immediately covered with a second sheet. In most cases, the cigarettes will remain in place throughout the test; however, if the cigarettes show a marked tendency to roll off the tape edge location, they may be supported with straight pins. Three straight pins may be inserted through the bottom sheet and tape at a 45° angle such that one pin supports the cigarette at the top, one at the center, and one at the butt. The heads of the pins must be below the upper surface of the cigarette (see Figure 2).

Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

c. *Quilted locations.* If quilting exists on the test mattress, each of three burning cigarettes shall be placed in a depression caused by quilting, directly over the thread and on the bottom sheet, and immediately covered with the top sheet. If necessary, a thin rod may be used to depress the bottom sheet into a depression. If the quilt design is such that the cigarettes cannot burn their full lengths over the thread, then the cigarettes shall be positioned in a manner which will allow as much of the butt ends as possible to burn on the thread. Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

d. *Tufted locations.* If tufting exists on the test mattress, each of three burning cigarettes shall be placed in the depression caused by tufting, directly over the tuft and on the bottom sheet, and immediately covered with the top sheet.

If necessary, a thin rod may be used to depress the bottom sheet into a depression. The cigarettes shall be positioned so that they burn down into the depression caused by the tuft and so that the butt ends of the cigarettes burn out over the buttons or laces used in the tufts. Report results for each cigarette as nonignition (N) or ignition (I) as defined in the acceptance criteria.

.5 *Laundrying.* Mattress pads shall be tested in accordance with "4 Test Procedure" in the condition in which they are intended to be sold, and after they have been washed and dried 25 times according to the procedure prescribed in Method 124—1967 of the American

Association of Textile Chemists and Colorists washing procedure 6.2 (III), with a water temperature of $60 \pm 2.8^\circ \text{C}$. ($140 \pm 5^\circ \text{F}$), and drying procedure 6.3.2(B). Maximum load shall be 3.64 kg. (8 pounds) and may consist of any combination of test items and dummy pieces.

.6 *Sampling plans.* At least one mattress from each production lot shall be tested.

.7 *Labeling.* If a mattress contains any fire retardant treated components, it shall be labeled with the letter "T" pursuant to rules and regulations established by the Federal Trade Commission.

[FR Doc.71-13240 Filed 9-8-71;8:50 am]

FEDERAL REGISTER, VOL. 36, NO. 175—THURSDAY, SEPTEMBER 9, 1971

DEPARTMENT OF COMMERCE

Office of the Secretary

[15 CFR Part 7]

MATTRESSES

Proposed Flammability Standard

In F.R. Doc. 71-13240 appearing at pages 18095-18098 in the issue for Thursday, September 9, 1971, at the end of the Proposed Flammability Standard for Mattresses (Doc. PFF 4-71), insert the following figures 1 and 2.

Issued: September 29, 1971.

JAMES H. WAKELIN, Jr.,
Assistant Secretary for Science and Technology.

MATTRESS PREPARATION CIGARETTE LOCATION

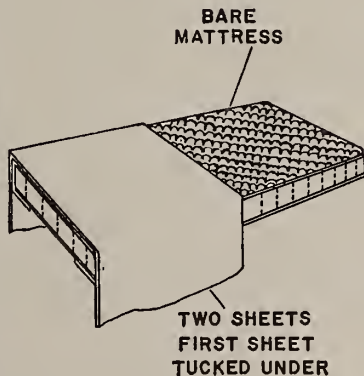


FIGURE 1

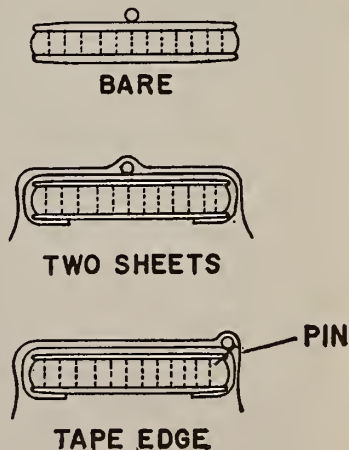


FIGURE 2

[FR Doc.71-14512 Filed 10-4-71;8:45 am]

FEDERAL REGISTER, VOL. 36, NO. 193—TUESDAY, OCTOBER 5, 1971

U.S. DEPARTMENT OF COMMERCE
OFFICE OF THE SECRETARY

Reprinted from Federal Register Volume 36, Number 158, August 14, 1971
(Page 15465)

**CHILDREN'S SLEEPWEAR
SAMPLING PLAN**

**Notice of Finding That Amendment
To Flammability Standard May
Be Needed and Institution of
Proceedings**

Finding. Pursuant to section 4(a) of the Flammable Fabrics Act, as amended (sec. 3, 81 Stat. 569; 15 U.S.C. 1193) and § 7.5 of the Flammable Fabrics Act procedures (33 F.R. 14642, October 1, 1968), and upon the basis of investigations or research conducted pursuant to section 14 of the Flammable Fabrics Act, it is hereby found that sampling plans may be needed to detect noncomplying fabrics and garments before they are placed on the market in order to provide increased protection to the public against unreasonable risk of the occurrence of fire leading to death or personal injury or significant property damage. Confirmation of this preliminary finding of need will require appropriate amendment of the Standard for the Flammability of Children's Sleepwear, DOC FF 3-71 (36 F.R. 14062).

The test upon which the children's sleepwear standard is based destroys the items being tested and, thus, all items cannot be tested. In order to obtain acceptably high levels of compliance and to maintain a reasonable frequency of testing, it is, therefore, necessary to have

statistically based sampling plans. Comments received during the development of the standard and from other presentations to the Department of Commerce tend to corroborate the need for sampling plans. Thus, children can be given increased protection by providing as part of the testing procedure in the children's sleepwear standard statistically based sampling plans for fabrics and garments. These sampling plans would also provide a framework for premarket testing and thus assist greatly in detecting noncomplying fabrics before they are placed on the market. Such plans should be based on recognized principles of statistical quality control and acceptable quality levels (AQL's). They should provide a sound basis for facilitating quality control of the products, and standardizing the frequency of testing.

Institution of proceedings. Pursuant to section 4(a) of the Flammable Fabrics Act, as amended (sec. 3, 81 Stat. 569; 15 U.S.C. 1193) and § 7.6(a) of the Flammable Fabrics Act Procedures (33 F.R. 14642, Oct. 1, 1968), notice is hereby given of the institution of proceedings for the development of appropriate sampling plans for items of children's sleepwear and for all fabrics or related materials intended or promoted for use in children's sleepwear.

All interested persons are invited to submit written comments or suggestions within 30 days after date of publica-

tion of this notice in the FEDERAL REGISTER, relative to (1) the above finding that sampling plans may be needed; and (2) the terms or substance of sampling plans that might be adopted in the event that a finding is made by the Secretary of Commerce that such an amendment to the standard (DOC FF 3-71) is needed to adequately protect the public against unreasonable risk of the occurrence of fire leading to death or personal injury, or significant property damage. Written comments or suggestions should be submitted in at least four (4) copies to the Assistant Secretary for Science and Technology, Room 3862, U.S. Department of Commerce, Washington, D.C. 20230, and should include any data or other information pertinent to the subject.

The written comments received pursuant to this notice will be available for public inspection at the Central Reference and Records Inspection Facility of the Department of Commerce, Room 7046, Main Commerce Building, 14th Street between E Street and Constitution Avenue NW., Washington, DC 20230.

Issued: August 10, 1971.

JAMES H. WAKELIN, Jr.,
Assistant Secretary for
Science and Technology.

[FR Doc.71-11736 Filed 8-13-71;8:46 am]



Figure 1. Children's Sleepwear Test Cabinet.



Figure 2. Burner for Children's Sleepwear Test Cabinet.



Figure 3. Specimen Holders for Children's Sleepwear Test Method.

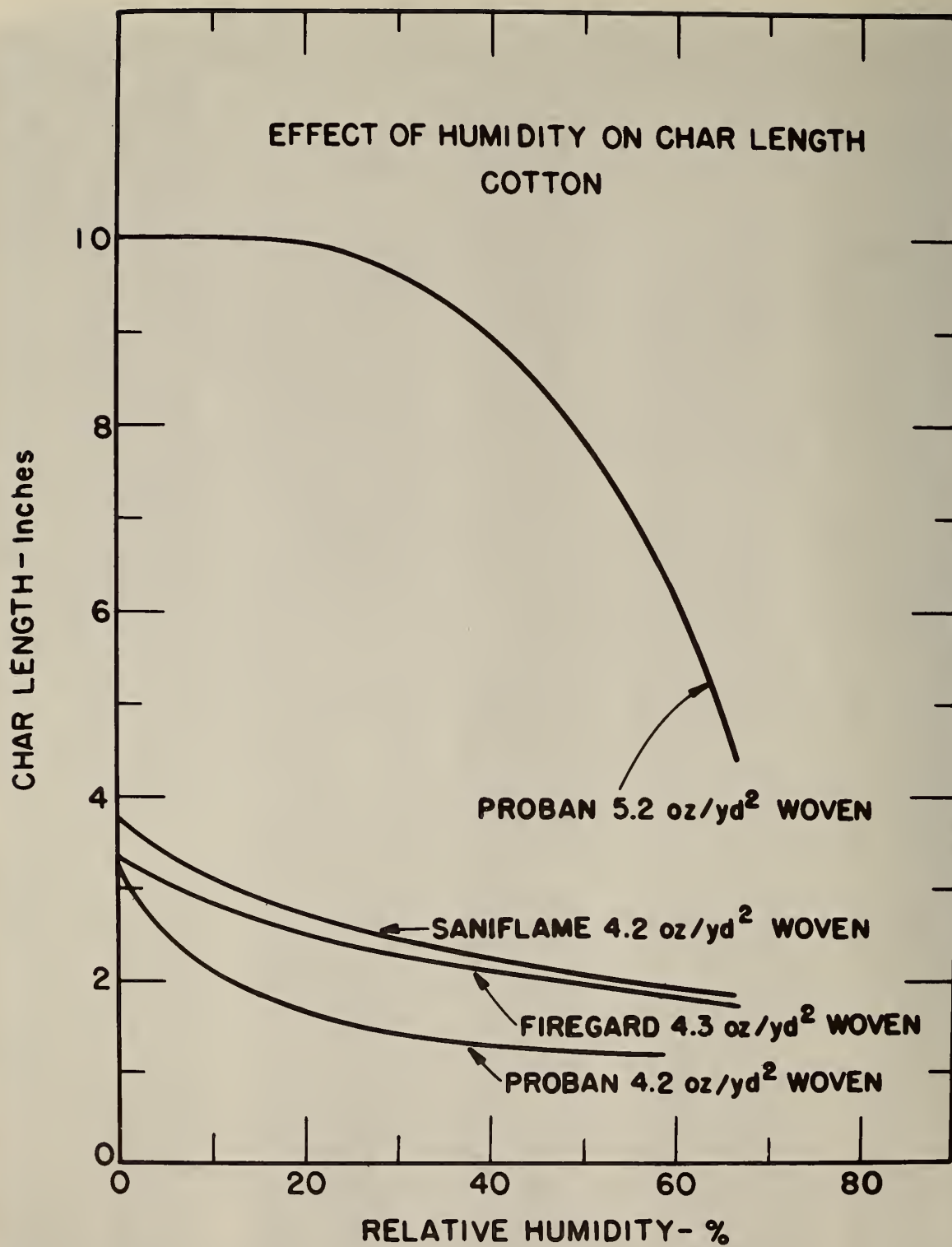


Figure 4. Effect of RH on Char Length of Cotton.

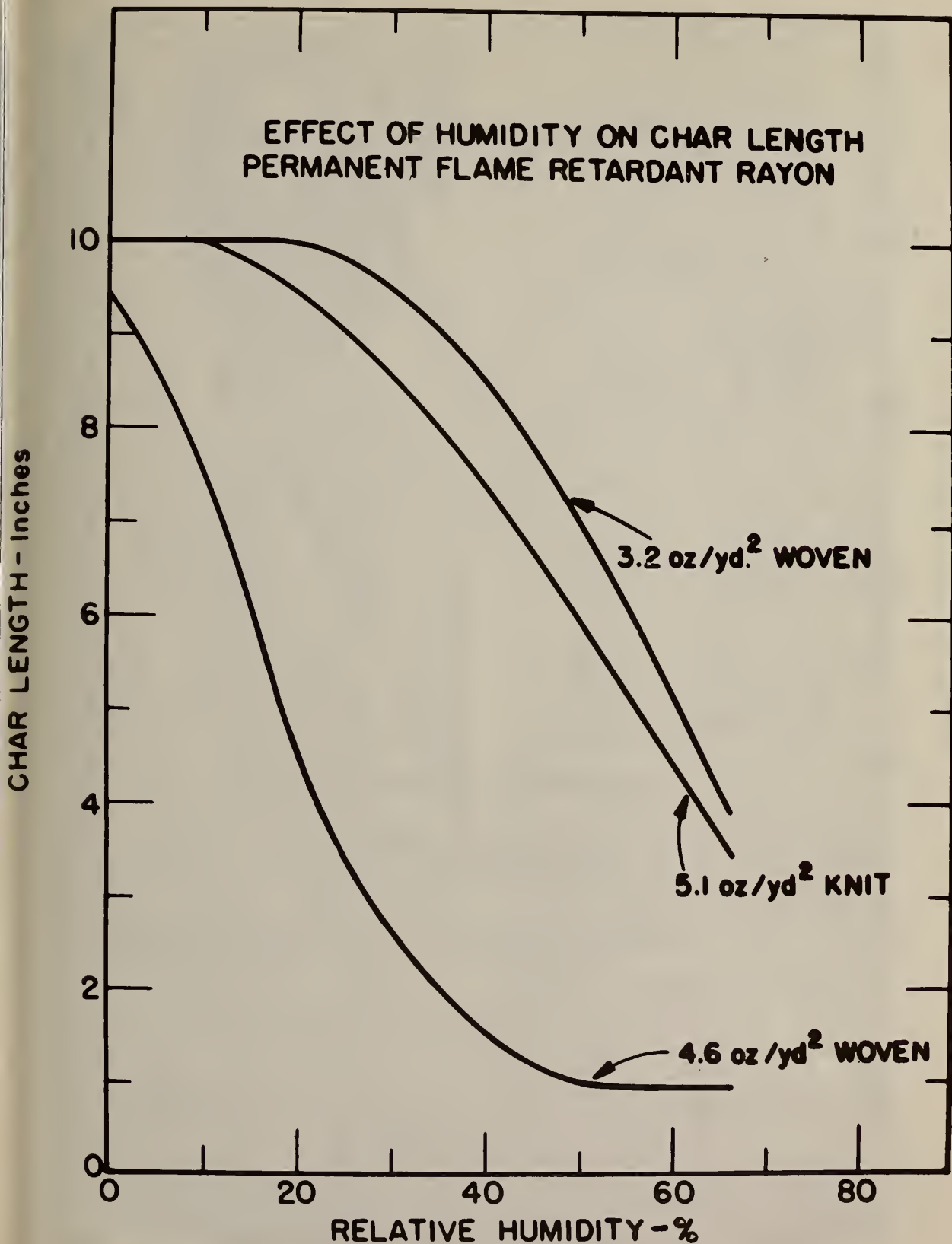


Figure 5. Effect of RH on Char Length of PFR Rayon.

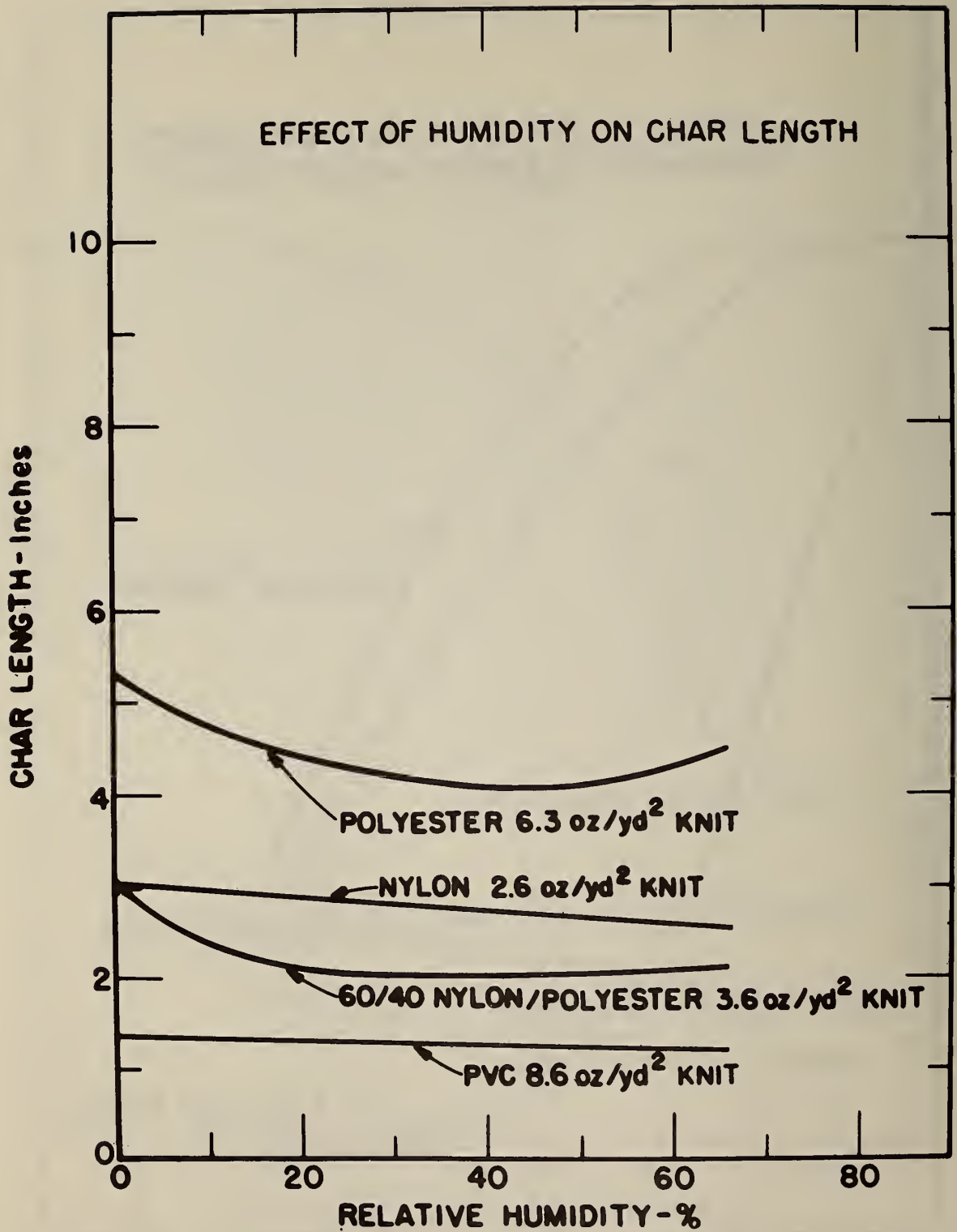


Figure 6. Effect of RH on Char Length of Nylon and Polyester.



Figure 7. Mattress Test - Cigarette on Surface, Bare Mattress.



Figure 8. Mattress Test - Cigarette in Quilted Area,
Bare Mattress.



Figure 9. Mattress Test - Cigarette on Tape Edge, Between Sheets.



Figure 10. Blanket Test - Bare and Specimen Holder.



Figure 11. Blanket Test - Flame Impingement on Specimen.



Figure 12. Interior View of Corridor. Fire Room at Right Rear.
Thermocouples on Walls in Center of Corridor,
Radiometers in Floor.



Figure 13. Interior View of Corridor Looking Toward Exit Window. Side Doors are Closed During Test. Smoke on Right Wall Beyond Door.

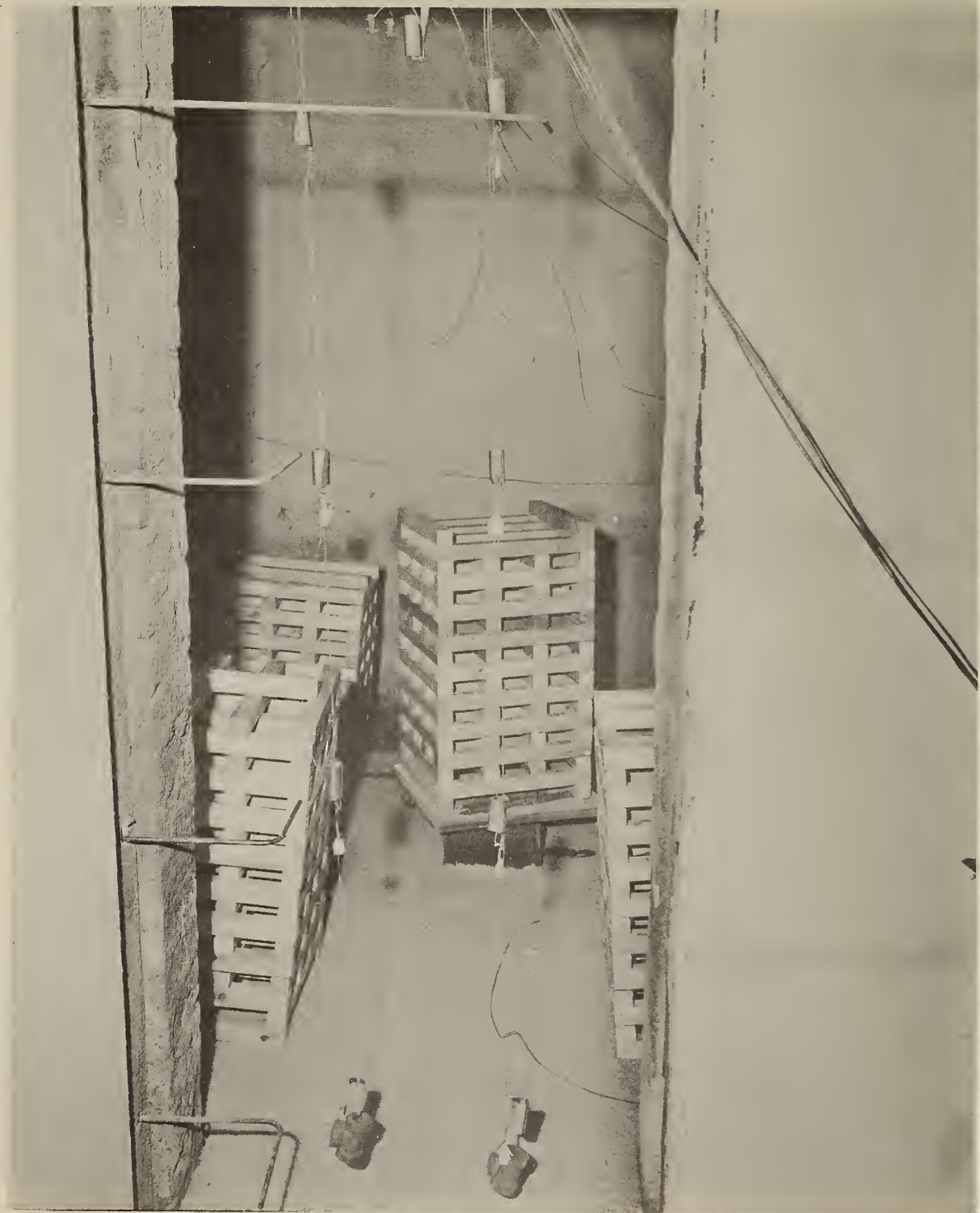


Figure 14. View in Corridor Fire Room Door Showing Wood Cribs. Center Crib on Load Cell. Thermocouples and Pilot Tubes in Doorway.

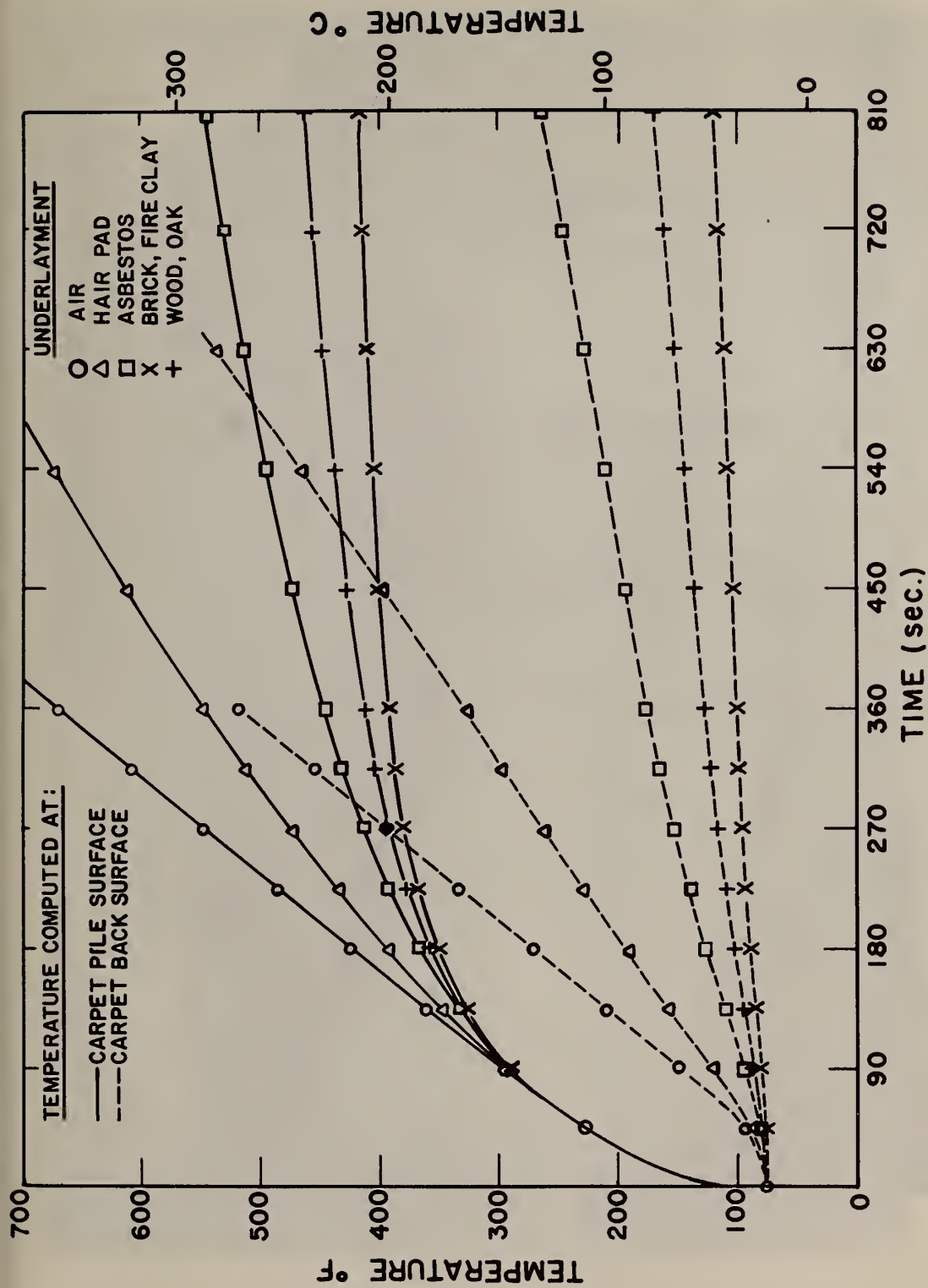


Figure 15. Carpet Surface Temperatures for Different Backing Materials.



Figure 16. Carpet Flammability Duct Apparatus. Air Supply System at Right, Combustion Chamber at Left.

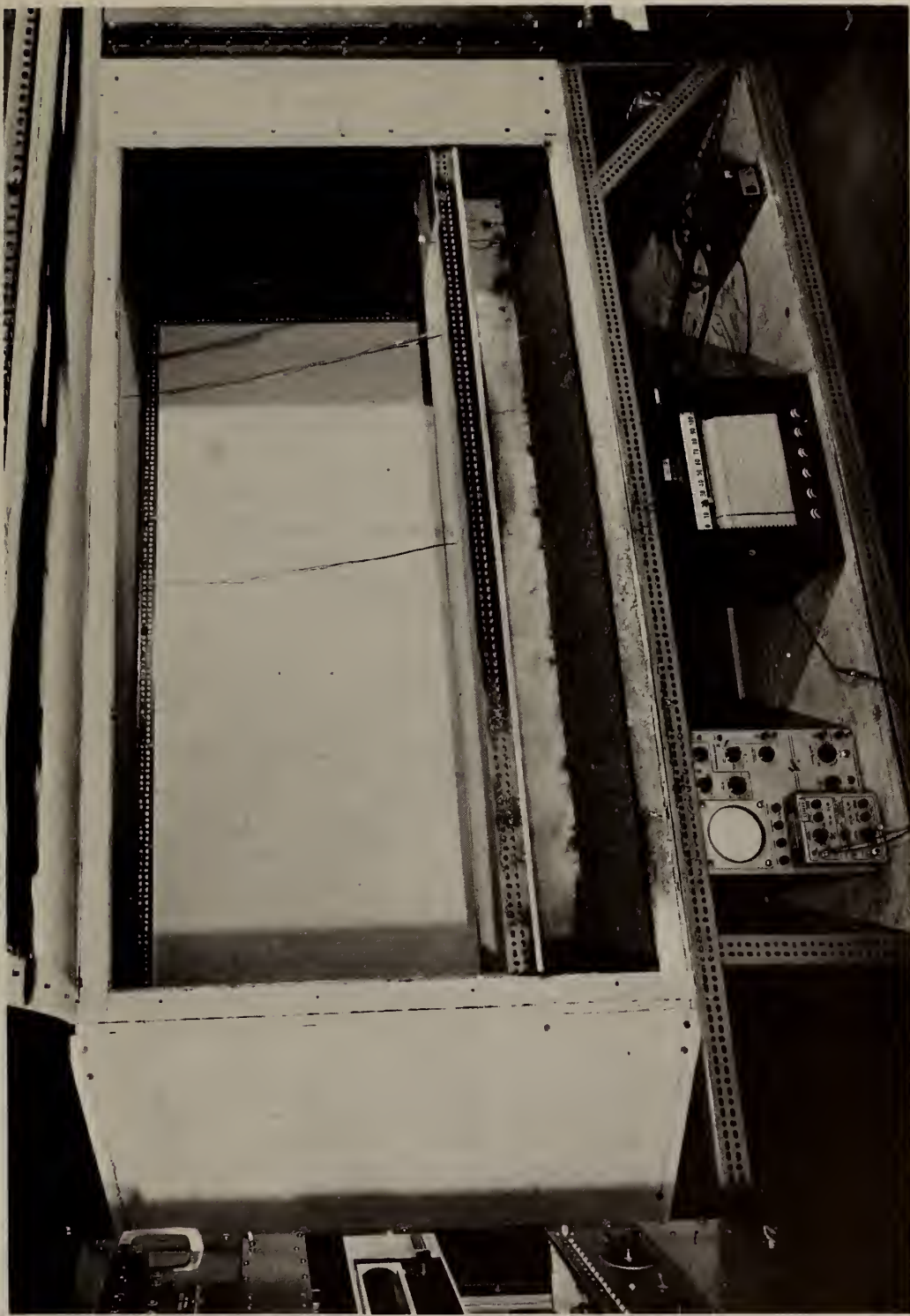


Figure 17. Carpet Flammability Duct Apparatus. Combustion Chamber Open Showing Carpet in Place and Ceiling at One Foot Level. Data Acquisition Equipment at Left.

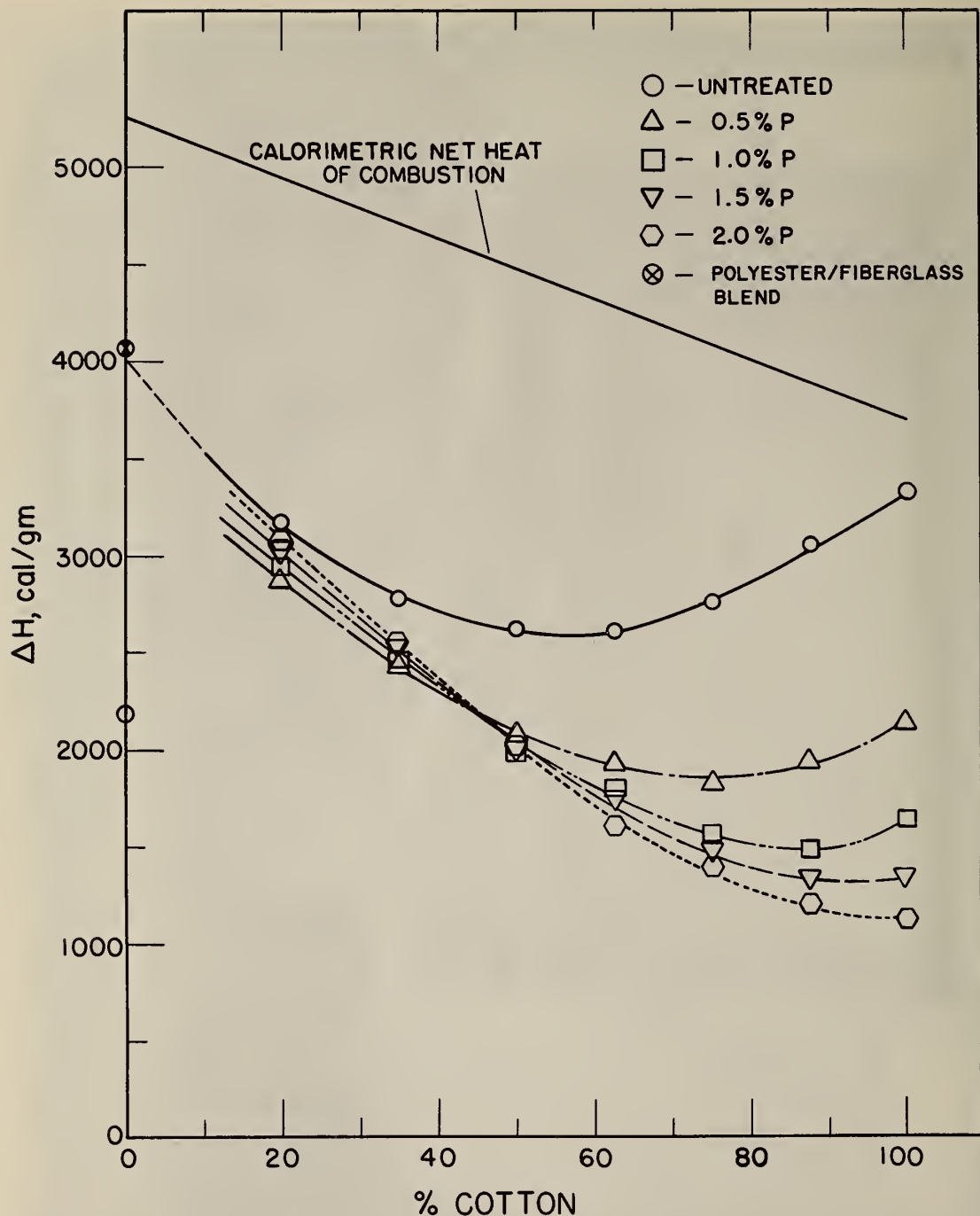


Figure 18. Heat of Combustion of Fire Retardant Treated Polyester / Cotton Blends. Note that 100% Polyester (on 0% Cotton Ordinate) Released about Half as much Heat as Polyester Blended with Glass Fiber (also on 0% Cotton Ordinate), and the Latter Fell on the Curve of Polyester / Untreated-Cotton Blends, Illustrating the Effect of Support on the Flammability of Polyester.

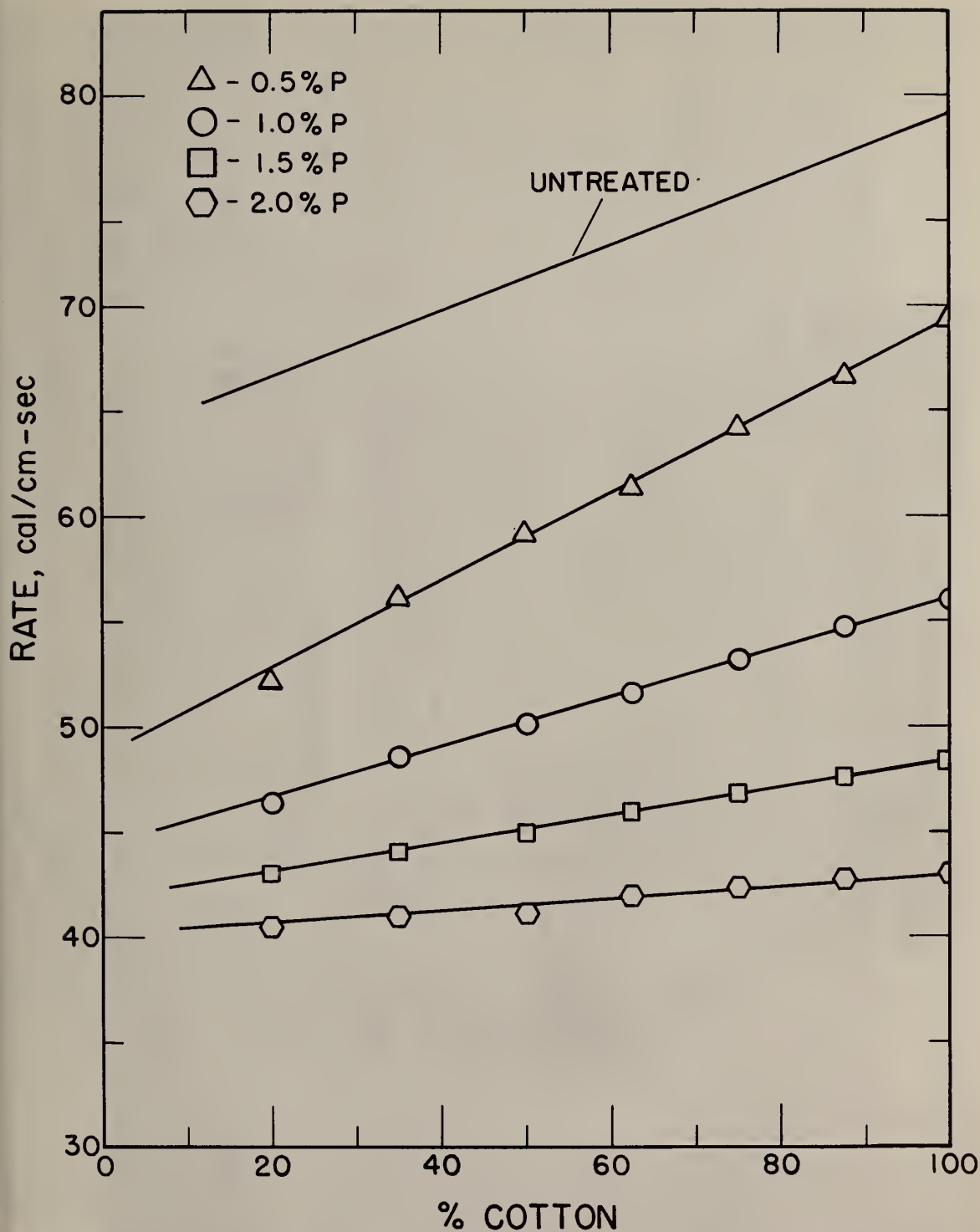


Figure 19. Rate of Heat Release of Fire Retardant Treated Polyester/Cotton Blends.

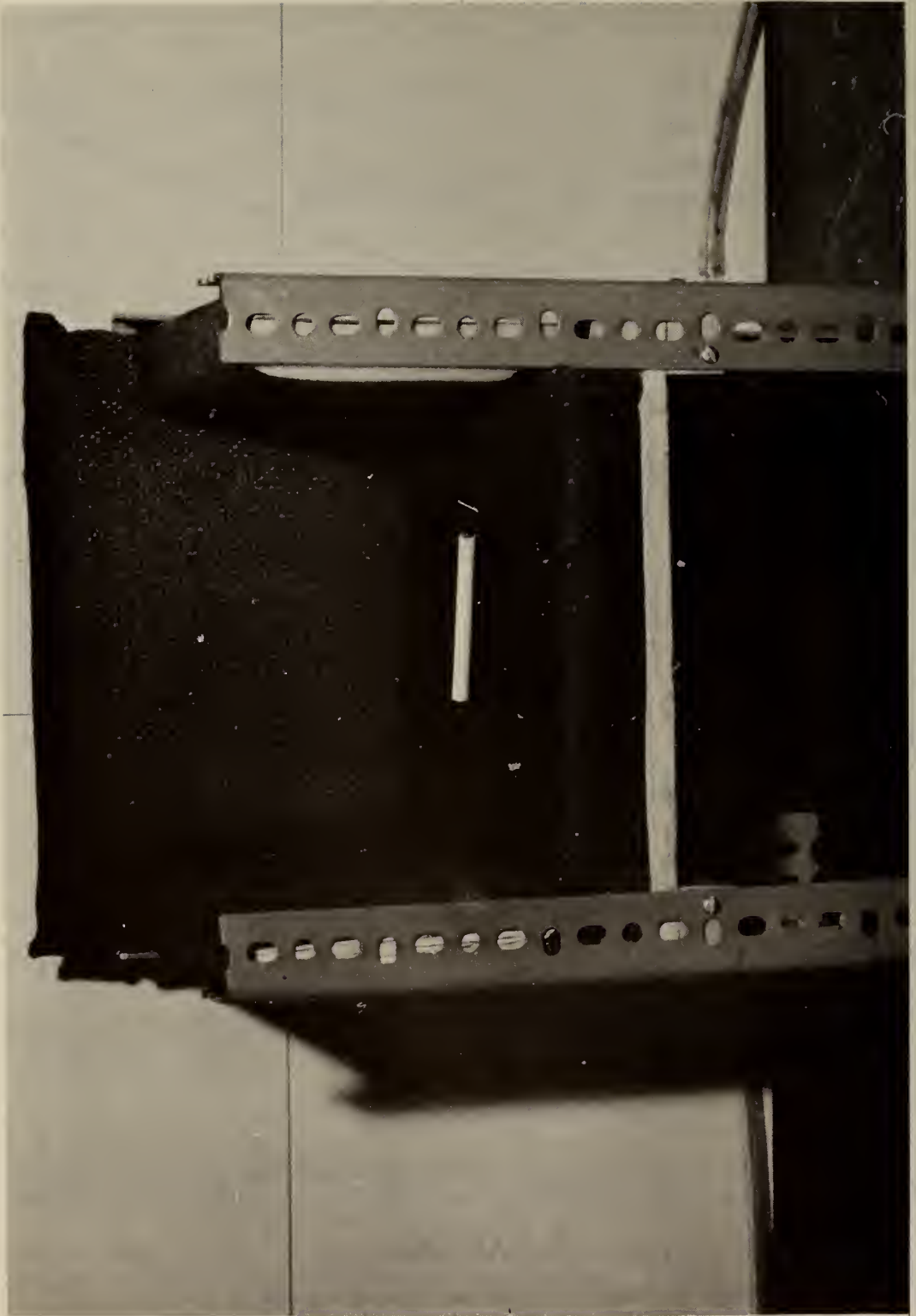


Figure 20. Upholstered Furniture Simulation - Horizontal Area.



Figure 21. Upholstered Furniture Simulation - Cigarette Against Chair Arm.

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15. SUPPLEMENTARY NOTES Publication of Annual Report to Congress required by Flammable Fabrics Act as amended.			
16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) This Annual Report to the Congress, required by the Flammable Fabrics Act, covers calendar year 1971. Specific flammability standards outputs were standards for children's sleepwear in sizes 0 through 6X, a proposed standard for mattresses, and a finding of possible need for amendment of the children's sleepwear standard to add sampling plans for the periodic testing by manufacturers of subject garments and materials. Research included studies, in-house and under contract, on subjects such as the contribution of floor covering systems to fire spread along building corridors and the parameters related to the burning of cotton/polyester blends and of multilayer fabrics. Studies of the feasibility of reducing flammability included the effects of treatments on combustion products and the effects of heavy metal ions on flammability. Test development, in addition to that basic to the standards developments already mentioned, included work on a blanket test, an upholstered furniture test, and on a general apparel test. A series of formal training sessions was initiated to supplement the continuing informal training, presentations, etc. Extensive cooperation was carried out with HEW, the public, industry, and voluntary standards groups.			
17. KEY WORDS (Alphabetical order, separated by semicolons) Annual report to Congress; blankets; children's sleepwear; flammability; flammability reduction; mattresses; research; sampling plans; standards; test development; upholstered furniture			
18. AVAILABILITY STATEMENT ☒ UNLIMITED. ☐ FOR OFFICIAL DISTRIBUTION. DO NOT RELEASE TO NTIS.		19. SECURITY CLASS (THIS REPORT) UNCL ASSIFIED	21. NO. OF PAGES 92
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